

MONOGRAPH
ON
BENZOIC ACID
AND
SODIUM BENZOATE

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BENZOIC ACID
and
SODIUM BENZOATE

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BENZOIC ACID
and
SODIUM BENZOATE

Summary

The benzoates, both sodium benzoates and benzoic acid, have been investigated extensively for the past hundred years. Essentially, the mechanism for detoxification of benzoates in the body has been known for 50 years. Biochemical work since that time has centered on elaboration of the effects of the benzoates on enzyme systems and on interactions of various drugs and body chemicals with the benzoates.

The absorption of benzoates from the gastrointestinal tract is very rapid and complete (1064, 1168, 1169, 1170). The benzoates are detoxified in the liver by conjugation with glycine resulting in hippuric acid formation (21, 195, 1064, 1474). When insufficient glycine is available benzoyl glucuronide is formed as an alternative (1064, 1474). Elimination is rapid, with 75-100% of the dose appearing in the urine in the first six hours after administration (680, 1064) and the rest within 2-3 days (153). No accumulation of the benzoates or their metabolites has been observed (750).

Glycine depletion caused by benzoate detoxication results in the reduction of creatine (183), glutamine (527), urea (1215, 1319), and uric acid (1064, 1319) formation. The benzoates affect the blood by accelerating autoxidation of oxyhemoglobin (563, 671, 1383, 1463) and myoglobin (662), promoting oxidative disintegration of hemoglobin (563), and shortening prothrombin time (566). The benzoates alter the metabolism of lipids and electrolytes (723). Oxidative phosphorylation is uncoupled from respiration by benzoates in mitochondria (164). The benzoates also inhibit a variety of enzymes (53, 184, 509, 549, 580, 651, 681, 714, 1232).

Simultaneous administration of benzoate and aspirin increases the concentration and persistence of aspirin in the body (21, 673, 772). Benzoate also increases the effects of procaine, lidocaine, cocaine, tetracaine and dibucaine (902). Under conditions of severe restriction of fluid and salt intake, benzoate increases and prolongs the level of serum penicillin (142, 198, 1444). Sodium bisulphite (1218) and sodium chloride (246) have been found to have synergistic effects with benzoates.

There have been many feeding studies conducted with benzoate sources, that is, benzoic acid or sodium benzoate. Long-term feeding studies have, without exception, used benzoic acid in the dosage regimen. A majority of short-term studies, on the other hand, have used sodium benzoate.

Special studies concerned with the teratogenicity and carcinogenicity of benzoic acid have been conducted within the last several years. Within the past ten years or so work done in Germany, Romania, and the Soviet Union has indicated that previous concepts of the long-term toxicity of the benzoates may have to be reevaluated.

Following is an integrated summation of feeding studies conducted on both sodium benzoate and benzoic acid.

Shtenberg and Ignat'ev fed male and female mice 80 mg of benzoic acid/kg/day for 3 months (1218). At this level, benzoic acid-fed mice showed a significant weight depression (1218). In a long-term feeding study with mice, the same authors found that a dosage level of 40 mg of benzoic acid/kg/day for 17 months resulted in a decreased level of response to physiological stress among test mice (1218). Ignat'ev reported that benzoic acid fed at a level of 80 mg/kg/day for 18 months resulted in a negative effect on body weight and vitality of mice (589). After 18 months on this regimen, the mice had increased liver weights and enlarged spleens, ovaries, and lungs; in addition, the detoxifying capacity of the liver for CCl₄ was lowered (580).

Fanelli and Halliday found that male rats fed sodium benzoate at 5686 mg/kg/day and female rats fed at 7780 mg/kg/day died of sodium benzoate intoxication within 2 weeks (374). Deuel, et al., reported that rats fed sodium benzoate for 90 days at a dosage of 6290 mg/kg/day exhibited marked toxic effects (317). Kieckebusch and Lang found that sodium benzoate fed at a level of 5000 mg/kg/day resulted in the death of 19 of 28 young test rats within 2 weeks and the remaining 9 by the end of the third week (670).

Griffith fed rats sodium benzoate at 3000 mg/kg/day for 40 days with the result that the test animals showed a distinct growth depression and a 33% mortality attributable to the benzoate (477). Another study at the 3000 mg/kg/day level conducted by Harshbarger showed a 25% mortality of the test rats and obvious toxic effects of sodium benzoate over the 4-5 week duration of feeding (530). Kreis, et al., fed benzoic acid to rats for periods up to 35 days and carried out meticulous histopathological examination of the brain. They found that brain damage occurred after 5 days when benzoic acid was fed at a dosage of 3000 mg/kg/day (729).

Four of 5 mature rats died within 4-5 weeks when fed sodium benzoate at a level of 2500 mg/kg/day by Kieckebusch and Lang (670). In contrast to the above study, a feeding study conducted by Deuel, et al., revealed that sodium benzoate at a dosage of 2620 mg/kg/day for 90 days resulted in no visible effects in test rats (317). Fanelli and Halliday corroborated this study by noting no effects in female rats fed 2200 mg of sodium benzoate/kg/day for 28 days; however, male rats in this same experiment showed growth depression at a dosage level of 2000 mg of sodium benzoate/kg/day for 28 days (374).

White found that sodium benzoate fed to rats at a level of 1650 mg/kg/day for 3-6 weeks (4 rats were continued on this regimen for 23 weeks) resulted in marked growth inhibition (1462). Kramer and Tarjan, however, reported no effects from sodium benzoate at a level of 1500 mg/kg/day for 4-8 weeks (725). At a dosage level of 1100 mg/kg/day for 35 days, benzoic acid administered to test rats by Kreis, et al., resulted in retarded growth and impaired food utilization but failed to show any neuropathologic changes (729). Sporn, et al., fed rats benzoic acid at 1 g% (1000 mg/kg)/day for over 11 weeks (1279). Although the benzoic acid at this level depressed the growth rate after 3 weeks, the effect was not readily apparent until after the 11th week (1279). Smyth and Carpenter fed rats sodium benzoate for 30 days at a level of 1090 mg/kg/day and reported that test animals showed no ill effects (1249). Harshbarger likewise observed no evidence of ill effects in rats fed 1000 mg of sodium benzoate/kg/day for 4-5 weeks (530). Marquardt fed rats 750 mg

of benzoic acid/kg/day for 18 months and reported that these animals exhibited decreased food intake and suppressed growth (832).

Kieckebusch and Lang fed benzoic acid at levels of 250 mg/kg/day and 500 mg/kg/day to rats over their entire life-span and continuing over 4 generations of test animals without observing any sign of toxicity (670). One rat fed 500 mg/kg/day lived for 1346 days on the benzoic acid regimen (670). At the 250 mg/kg/day level, life-span of the animals was actually increased (670).

Shtenberg and Ignat'ev fed rats 40 mg/kg/day of benzoic acid for 18 months and then challenged them with a massive dose of 4000 mg of benzoic acid/kg (1218). This resulted in only a 25% mortality, and the workers interpreted this to be indicative of an acquired tolerance to benzoate intoxication through chronic exposure (1218). Ignat'ev reported that in a study conducted on rats over an 18 months period, benzoic acid at a level of 80 mg/kg/day had no effect on body weight, viability, macro or microstructure of parenchymatous organs (589). Furthermore, rats on this regimen survived challenge with a single dose of 4000-5000 mg of benzoic acid/kg (589).

Lucas reported that a dog fed 1000 mg of sodium benzoate/kg/day for 2 days exhibited symptoms of severe intoxication (801). Another dog fed a total dosage of 1430 mg/kg over a 3 day period died (801).

Gerlach reported that 500 mg and 1000 mg of benzoic acid administered daily to humans for 44 consecutive days resulted in no visible effects (443). He also mentioned that 1000 mg of benzoic acid/man/day for 88 days and for 82 days resulted in no unfavorable effects on test subjects (443). Wiley and Bigelow, however, reported that of 12 individuals tested, only 3 could tolerate 35 g of benzoic acid over a 20 day period (1470). Lucas reported also that a single dose of 2000-3000 mg of sodium benzoate in apple cider was toxic for man (801).

In a special study, Minor and Becker injected sodium benzoate at a level of 1000 mg/kg into rats on gestational days 9-11 or 12-14 and found that sodium benzoate exhibited a fetotoxic and teratogenic effect at this level (884). However, no gross anomalies were observed at dosage levels of 100 and 300 mg/kg (884). Dinerman and Ignat'ev reported that Ehrlich ascites carcinoma was more readily implanted in mice receiving benzoic acid in the diet at a level of 300 mg/kg/day for 3 months than in control animals (327).

BENZOIC ACID

Chemical Information

I. Nomenclature

A. Common Names

1. Benzoic Acid
2. Dracylic Acid

B. Chemical Name

1. Benzoic Acid
2. Phenylformic Acid

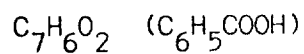
C. Trade Name

Benzenecarboxylic acid

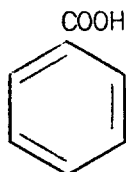
D. Chemical Abstracts Services Unique Registry Number

000065850

II. Empirical Formula



III. Structural Formula



IV. Molecular Weight

122.12

V. Specifications

A. Chemical

Freezing point	122.0-123.0°C
Residue after Ignition	0.005%
Insoluble in Methanol	0.005%
Chlorine compounds (as Cl)	0.005%
Sulfur compounds (as S)	0.002%
Heavy Metals (as Pb)	0.0005%
Substances reducing permanganate	passes A.C.S test

B. Food Grade	
Appearance and color	White crystals or needles
Odor	No off odor-slight odor of benzaldehyde
Melting range	121° to 123° C
Ash	0.05% Maximum
Heavy metals	20 ppm Maximum
Benzoic acid	99.5% Minimum
Chlorinated compounds	Passes test
Solubility	Passes test

C. Food Chemicals Codex	
Assay	Not less than 99.5% $C_7H_6O_2$ after drying
Solidification point	Between 121° and 123°
Limits of Impurities	
Arsenic	Not more than 3 ppm (0.0003%)
Chlorinated compounds (as Cl)	Passes test (about 0.08%)
Heavy metals (as Pb)	Not more than 10 ppm (0.001%)
Readily carbonizable substances	Passes test
Readily oxidizable substances	Passes test
Residue on ignition	Not more than 0.05%

VI. Description

A. General Characteristics

Benzoic acid is in the form of white crystals, scales, or needles. It is odorless or has a slightly benzoin- or benzaldehyde-like odor.

B. Physical Properties	
Melting point	122.4°
Boiling point:	
760 mm Hg	249.2°
400 mm Hg	227°
200 mm Hg	205.8°
100 mm Hg	186.2°
60 mm Hg	172.8°
Begins to sublime around	100°
Density	1.321
Volatile with steam	
Flash point	121-131°
K at 25°	6.40×10^{-5}
pH of a saturated solution at 25°	2.8
Vapor pressure	1 mm Hg at 96.0°
Vapor density	4.21
Solubility in water:	

At 0°	1.7 g/l
At 10°	2.1 g/l
At 20°	2.9 g/l
At 25°	3.4 g/l
At 30°	4.2 g/l
At 40°	6.0 g/l

At 50°	9.5 g/l
At 60°	12.0 g/l
At 70°	17.7 g/l
At 80°	27.5 g/l
At 90°	45.5 g/l
At 95°	68.0 g/l

The solubility in water is increased by alkaline substances such as borax.

Mixtures of excess benzoic acid and water form two liquid phases at 89.7°. The two liquid phases unite at the critical solution temperature of 117.2°. The composition of this critical mixture is 37.34% benzoic acid and 67.66% water.

One gram of benzoic acid dissolves in 2.3 cold alcohol and 1.5 ml boiling alcohol. One gram also dissolves in 4.5 ml chloroform, 3 ml ether, 3 ml acetone, 30 ml carbon tetrachloride, 10 ml benzene, 30 ml carbon disulfide, and in 23 ml oil of turpentine. Benzoic acid is also soluble in volatile and fixed oils. It is slightly soluble in petroleum ether.

C. Stability

Benzoic acid should be stored in well-closed containers in a cool, dry place.

VII. Analytical Methods

There are various methods for the qualitative determination of benzoic acid. Benzoic acid may be crystallized from ether and dissolved in hot water. The precipitate formed when NH_4OH is added, is dissolved in a few milliliters of hot water. Presence of benzoic acid is indicated by the salmon-colored precipitate of ferric benzoate when a few drops of aqueous 0.5% FeCl_3 solution is added.

Another qualitative test for benzoic acid is the modified Mohler test where H_2SO_4 and KNO_3 are added to the residue formed from alkaline benzoic acid solution. The mixture is heated, cooled and water is then added to it. When colorless $(\text{NH}_4)_2\text{S}$ solution is added, the red-brown ring formed between layers, indicates benzoic acid. On mixing and heating this solution, benzoic acid can be distinguished from cinnamic acid and salicylic acid. The presence of phenolphthalein interferes (39).

Hoyem developed a method using paper chromatography and ultraviolet spectrophotometry. Paper is spotted and placed in a chromatography tank containing n-butanol, ammonia and water (5:2:3) for 20 hours and exposed to ultraviolet light for development. This procedure can be quantitated by eluting the spots with either 0.01 N HCl or 0.01 N NaOH and measuring at λ_{max} on a UV spectrophotometer (578).

Benzoic acid can be quantitated using titrimetry following separation from foods. After purification the residue is dissolved in alcohol and titrated to a phenolphthalein endpoint with NaOH. Vanillin interferes

with this technique (39).

Thin layer chromatography (TLC) has been used to separate and identify preservatives. A TLC system has been reported using polyamide-silica gels as the mobile phase. Solvent systems such as methanol-water (6:4), Acetone-water (5:5), methanol-ethanol-water (5:1:4), methanol-concentrated NH_3 -water 2:1:7, ethanol-water (3:7), and n-Hexane-ethanol (8:2). This method has been used to separate salicylic acid, p-hydroxybenzoic acid, ethyl p-hydroxybenzoate, n-propyl p-hydroxybenzoate, n-butyl p-hydroxybenzoate, benzoic acid, sorbic acid and dehydroacetic acid (931).

Benzoates can be determined in the presence of sorbates using the method of Buglio (212). A column is prepared by packing it with a diatomaceous earth: bicarbonate mixture. The benzoate solution is acidified and extracted with benzene and Na_2SO_4 . The solution is then hydrogenated with a Pd as a catalyst. This step hydrogenates the sorbic acid. The solution is then passed through the column, washed with ether and eluted with 10% glacial acetic acid in ether. The eluent is analyzed on a recording spectrophotometer (from 340 to 250 millimicrons versus a blank). Ninety-nine \pm 0.85% recovery was obtained for benzoate.

Benzoic acid can also be quantitated using spectrophotometry. The sample is extracted with ether, washed with HCl and then NH_4OH . The absorbance of the solution is measured at 272 millimicrons and compared to a previously prepared standard curve. This method is applicable to catsup, other tomatoe products, jams, jellies, beverages containing small amounts of alcohol, soft drinks and fruit juices. This method is not applicable to solids (39).

The above method has been streamlined for the detection of benzoic acid and sorbic acid in fruit beverages. Benzoic acid has a strong absorption maximum at 225 millicrons which is ten times that at 272 millimicrons. A small sample can thus be dissolved in ethyl ether which then is dissolved by adding petroleum ether and sodium sulfate. Usually a beverage will not contain both benzoic and sorbic acids but if such a mixture exists, the two must be separated by thin layer chromatography or gas chromatography. Fumaric acid may interfere at the measuring wavelength but is not usually present in fruit beverages. Since other UV absorbing compounds are present in nonfruit beverages, this method can not be used for them (435). A method for the quantitative determination of benzoic acid using ion exchange chromatography has been developed. The chloride form of De-Acidite FF was used as the resin. The sample is added to centrifuge tubes containing CaCO_3 . After water and ethanol are added, the sample is centrifuged. The supernatant is placed on the prepared column and washed down with a sodium chloride solution in ethanol. The eluant is treated with HCl and CuSO_4 and measured at 220, 230 and 245 millimicrons on a spectrophotometer. This method is especially useful for soft drinks, fruit bases and compounds, and gives recoveries of greater than 22% with standard deviations of less than 4% (407).

Polarography has also been used in quantitate benzoic acid. In this method benzoic acid is nitrated and the nitroderivative is analyzed. A sample extract containing $0.1 - 1.0 \times 10^{-3}$ moles of benzoic acid is treated with H_2SO_4 - HNO_3 and measured polarographically. This method was used for fruit juices and syrups. Standard deviation was 5% with a 6%

distribution at 95% statistical reliability (296).

Semimicro qualitative analysis can be used to identify benzoic acid. When the dry powder is stirred into a small quantity of lead triethylamine, crystalline 4-sided plates are formed singly or in groups. When the powder is stirred into a small quantity of zinc pyridine, hexagonal crystals are formed. If benzoic acid is dissolved in 2% triethanolamine (1:100 to 1:200) and silver nitrate is added, rods or curving blades with irregular ends are developed (39).

Gas chromatography has been used to detect methyl p-hydroxybenzoate and separate it completely from a mixture of sorbic acid, benzoic acid, salicylic acid, dehydroacetic acid, menadione and ethyl, butyl, and propyl p-hydroxybenzoate without any pretreatment. The column was packed with 30% DC 550 silicone on celite 545; the column temperature was 190° and the carrier gas was hydrogen (590).

VIII. Occurrence

Benzoic acid occurs in nature in free and combined forms. As much as 20% may be found in gum benzoin. Among the foods in which benzoic acid occurs naturally are cranberries, prunes, greengage plums, cinnamon and ripe cloves, most berries contain 0.05%. Nearly all vertebrates except birds excrete benzoic acid mainly as hippuric acid.

SODIUM BENZOATE

Chemical Information

I. Nomenclature

A. Common Names

1. Sodium benzoate
2. Benzoate of soda

B. Chemical Name

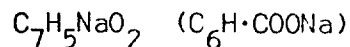
Sodium benzoate

C. No Trade Names

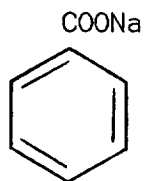
D. Chemical Abstracts Services Registry Number

000532321

II. Empirical Formula



III. Structural Formula



IV. Molecular Weight

144.11

V. Specifications

A. Chemical (U.S.P.)

Description

White, odorless, or nearly
odorless, granules, crystalline
powder or flakes

Solubility

1 g dissolves in 2 ml water

Identification (as Sodium)

Positive

(as Benzoic Acid)

Positive

Alkalinity (as Sodium hydroxide)

0.04% Maximum

Loss on Drying

1.5% Maximum

Heavy metals (as lead)

0.001% Maximum

Chlorinated compounds

0.07% Maximum

Arsenic

0.0003% Maximum

Assay

99.0% Minimum

Bulk density
Screen analysis #8 Mesh
minus #20
#80

35-70 fl. oz./lb.
99.0 Minimum

30% Maximum

B. Food
See A above

C. Food Chemicals Codex

Assay	Not less than 99% $C_7H_5NaO_2$, calculated on the dried basis
Limits of Impurities	
Alkalinity (as NaOH)	Not more than 0.04%
Arsenic (as As)	Not more than 3 ppm (0.0003%)
Chlorinated compounds (as Cl)	Passes test (about 0.07%)
Heavy metals (as Pb)	Not more than 10 ppm (0.001%)
Loss on drying	Not more than 1.5%

VI. Description

A. General Characteristics

Sodium benzoate occurs as white, odorless or nearly odorless, granules, crystalline powder or flakes. It has a sweetish, astringent taste without bitterness.

B. Physical Properties

At 0°C, 62.8 g dissolve in 100 ml water; at 20°C, 66.0 g dissolve in 100 ml and 74.2 g dissolve in 100 ml water at 100°C. In 100 ml ethyl alcohol, 0.81 gm dissolve at 0°C; 1.64 gm dissolve at 25°C and 8.30 gm dissolve at 78°C. One gram dissolves in 50 ml of 90% alcohol.

An aqueous solution of benzoic acid is alkaline to litmus and has a pH of around pH 8.

VII. Analytical Methods

See Benzoic Acid

VIII. Occurrence

Sodium benzoate does not occur naturally. However, benzoic acid from which it is derived occurs naturally in berries.

BENZOIC ACID

Biological Data

I. Acute Toxicity

Substance	Animal	Route	Dosage (mg/kg)	Measurement	Ref.
Benzoic Acid	Rat	I.V.	1590-1838	LD ₅₀	508
Benzoic Acid	Rat	P.O.	2000-2500	LD ₅₀	589
Benzoic Acid	Guinea Pig	I.P.	1400	LD ₁₀₀	508
Benzoic Acid	Rabbit	P.O.	2000	LD ₁₀₀	508
Benzoic Acid	Rabbit (Fasting)	P.O.	1520-1830	LD ₁₀₀	508
Benzoic Acid	Rabbit (Dry-Fed)	P.O.	1700	LD ₁₀₀	508
Benzoic Acid	Cat	P.O.	2000	LD ₁₀₀	508
Benzoic Acid	Dog	P.O.	2000	LD ₁₀₀	508

One sheep was given 79.7 gm of benzoic acid in 24 hours by rumen infusion. This animal refused food offered six hours after the infusion began. Severe muscular weakness accompanied by muscular tremors developed on the second day after infusion. The sheep died on the third day (834).

Another sheep was given 9.6, 22.4, and 54.0 gm of benzoic acid in 24 hours by abomasal infusion. No symptoms were observed. However, when 88 gm of benzoic acid were infused over 24 hours, the sheep died during the next 24 hours (834).

The death of one sheep three days after a dosage of benzoic acid at 1100 mg/kg and of another sheep one day after a dosage at 1800 mg/kg indicates that 1000 mg/kg is close to a lethal dose for sheep (834).

II. Short-Term Studies

Mice

Groups of 50 male and 50 female mice weighing 8-10 g and housed in groups of 10-25 received, by oral intubation, 0 or 80 mg/kg/day of benzoic acid. Feed and water were provided ad lib. The mice were observed for general condition and behavior and survival. Food consumption and weight gain were recorded daily. Tests were carried out to determine the effects of hunger, physical stress, and poisoning with carbon tetrachloride on the test animals compared with untreated controls. The feeding regimen was continued for three months (1218).

At the termination of the feeding regimen, surviving mice were subjected to a restricted dietary intake (reduced 90%) for up to five days. The mice received water ad lib, and the dosing regimen with benzoic acid was continued by oral intubation. Weight loss and mortality rate were recorded (1218).

Test animals grew significantly less than controls; although, this was not related to food intake. In fact, the average daily food intake for test mice was 2.57 and 2.65 respectively for males and females compared to 2.33 and 2.81 respectively for male and female controls. Female test mice had a daily food intake of 94% of that of the controls and a daily water intake of 85% of controls. Weight gain was 71% of controls. Male control animals, on the other hand, had a food intake of 90% of test mice and a water intake of 93% of test mice. In spite of this, male test mice showed a weight gain of only 66% of control mice (1218).

Rats

In a rather long discussion of toxicity criteria, Shporn, et al., mentioned a feeding study conducted on rats in which benzoic acid was fed to the animals receiving a stock diet containing 18% casein:

Substance	No. of Animals	Diet	Concentration	Growth Stimulation	
				Apparent	Real
Benzoic Acid	12	18% Casein	1 g%	11 wks.	3 wks.
Benzoic Acid	12	18% Casein	5 g%	7 wks.	2 wks.
Benzoic Acid	12	18% Casein	10 g%	3 wks.	1 wk.

The apparent stimulation means that the actual weight of the test animals is significantly higher than that of controls; whereas, the real stimulation means that the growth rate/animal is higher. The point is that a compound may have a deleterious effect (as in this case) despite an apparent stimulation in growth (1279).

The term 1 g% is apparently 1 gm/100 ml of benzoic acid solution. At this level, benzoic acid affects growth negatively after 5 weeks, but this does not become apparent until after the 11th week (1279).

Groups of growing male Royal Wistar rats, housed individually, were divided into groups and fed various regimens of benzoic acid (see table). Benzoic acid was incorporated in the diet, and food and water were provided ad lib (729).

Group		No. of Animals	Benzoic Acid		Test Duration
			% in Food	Days of Admin.	
A	I	5	3	1	1
	II	5	3	2	2
	III	5	3	3	3
	IV	8	3	5	5
B	I	10	3	5	5
	II	15	3	5	24 or 35
C	I	5	1.1	7	7
	II	8	1.1	14	14
	III	10	1.1	35	35
Control	I	5	0		3
Control	II	7	0		35

The three series (A,B,C) were set-up to determine the time after which organic damages first occur. Since 50% of the test animals given 3% benzoic acid died by the fifth day, this interval was taken to be the time at which all animals suffered damages. Animals surviving the fifth day in group B (series II) were put on a benzoic acid-free stock diet until the 24th or 35th day in order to determine damages extending beyond the duration of administration (729).

Animals were killed by decapitation and immediately dissected. Histological examination of heart, liver, and kidneys was carried out. After careful preparation, the brain was removed, imbedded in paraffin, sliced, and stained with haematoxylin-eosin or cresol violet (Kresylviolet). The brain was carefully examined for micropathologic change (729).

At the 3% benzoic acid dosage level, most animals would show abnormal behavior after 4-5 days. Restlessness, aggressiveness, tonic-clonic cramps, and fear reactions were characteristic. After 5 days, half the animals had died (729).

Brain damage was demonstrable histologically at the 3% benzoic acid level and consisted of necrosis of parenchymal cells of the stratum granulosum of the fascia dentata and of the cortex of the lobus piriformis. These changes occurred consistently after 5 days on the 3% level and occasionally after 3 days. Other organs, however, did not appear to be affected. The brain damage was still evident 19 or 30 days after benzoic acid feeding ceased (729).

At the 1.1% level for 35 days, benzoic acid retarded growth and impaired food utilization, but failed to show any neurotoxic signs of pathological changes in the brain (729).

Man

In experiments on human volunteers (numbers not given), including himself, Gerlach reported the effects of benzoic acid. The intake of 10 g of benzoic acid orally resulted in absolutely no effect on body temperature, pulse, respiration, digestion, or any other untoward effects. Benzoic acid administered at the rate of 0.5 g and 1.0 g (daily) for 44 consecutive days showed no visible effects; body weight of these individuals remained stable (443).

Eighty-two daily doses of 1 g benzoic acid over a period of 86 days or 88 daily doses of 1 g benzoic acid over a period of 92 days resulted in no recognizable unfavorable effects. Gerlach reports that a daily intake of 1 g benzoic acid for 6 consecutive days had no effect on serum albumin or on the utilization of nitrates and lipid components of foods (443).

A regimen was designed in which 12 individuals would be given benzoic acid orally as follows for 20 consecutive days: 1 g for 5 days, 1.5 g for 5 days, 2 g for 5 days, and 2.5 g for 5 days. Total dosage would be 35 g of benzoic acid over a 20 day period (1470).

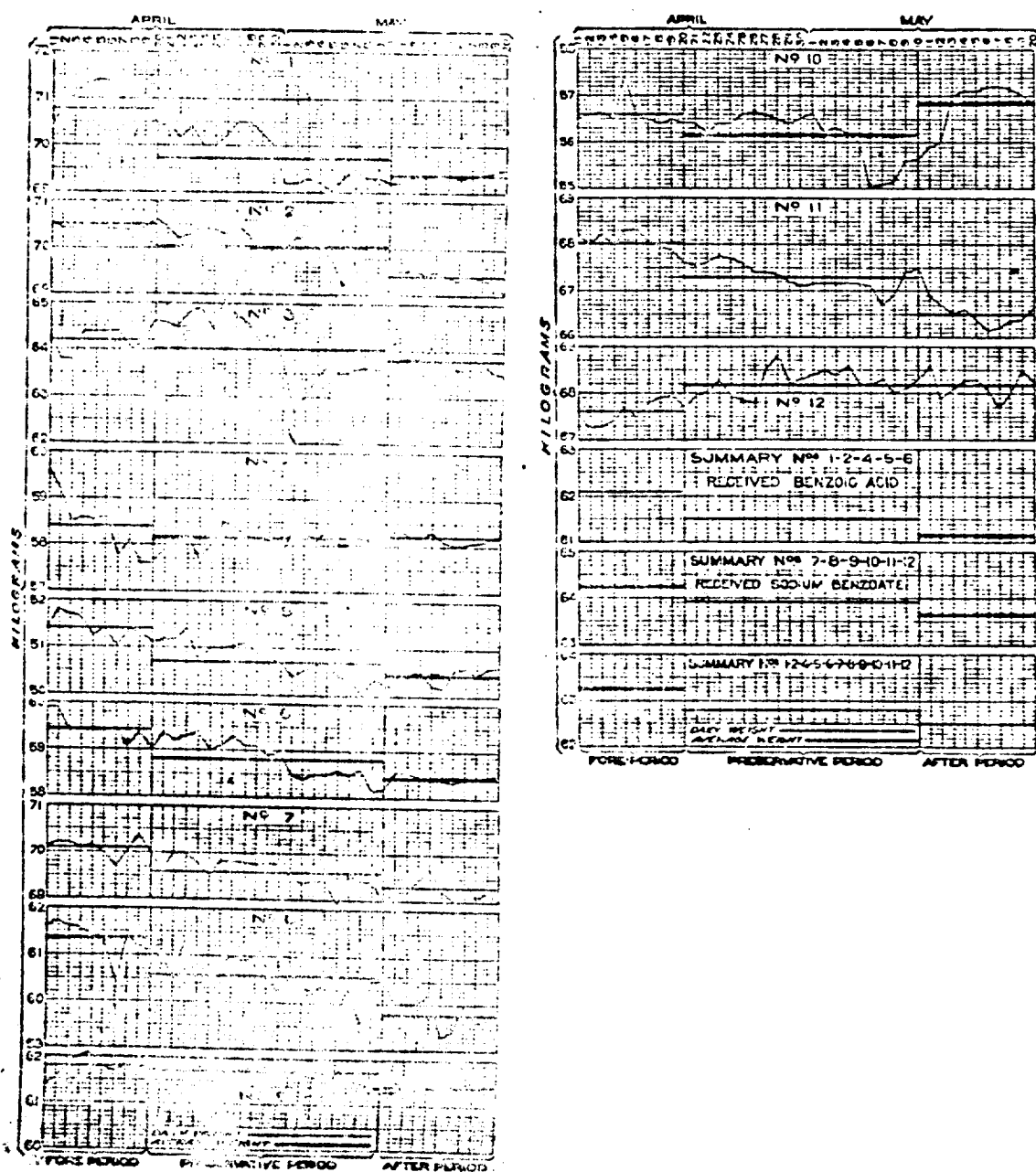
Following are tables (II and III) showing the schedule of administration and average body weights for test subjects: (1470)

TABLE II

Schedule of administration of preservative
(in capsules)

Dose	Dose in capsules											
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12
First day	70	70	64	68	51	54	64	60	60	60	67	68
Second day	70	70	64	68	51	54	64	60	60	60	67	68
Third day	70	70	64	68	51	54	64	60	60	60	67	68
Fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Tenth day	70	70	64	68	51	54	64	60	60	60	67	68
Eleventh day	70	70	64	68	51	54	64	60	60	60	67	68
Twelfth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Fourteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventeenth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Nineteenth day	70	70	64	68	51	54	64	60	60	60	67	68
Twentieth day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Twenty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirtieth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Thirty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Fortieth day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Forty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Fiftieth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Fifty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixtieth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Sixty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventieth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-first day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-second day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-third day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Seventy-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Eightieth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-first day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-second day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-third day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Eighty-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninetieth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-first day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-second day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-third day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-fourth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-fifth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-sixth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-seventh day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-eighth day	70	70	64	68	51	54	64	60	60	60	67	68
Ninety-ninth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundredth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and first day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and second day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and third day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and fourth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and fifth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and sixth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and seventh day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and eighth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and ninth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and tenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and eleventh day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and twelfth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and thirteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and fourteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and fifteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and sixteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and seventeenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and eighteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and nineteenth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and twentieth day	70	70	64	68	51	54	64	60	60	60	67	68
One hundred and twenty-first day	70	70	64	68	51</							

TABLE III



Average body weights

Of the 12 individuals tested, only 3 took the entire dosage of 35 g. Benzoic acid produced marked symptoms of discomfort and malaise. The most common symptoms were nausea and headache; although, weakness, burning and irritation of the esophagus, hunger and indigestion were also experienced (1470).

III. Long-Term Studies

Mice

Groups of 25 male and 25 female mice, weighing 10-15 g, were given 0 and 40 mg of benzoic acid/kg/day for 17 months. Benzoic acid was fed as a paste prior to the main feed, and food and water were provided ad lib. The mice were observed for general condition, behavior, and survival. Food consumption and weight gain were recorded daily. Further testing was carried out to determine the effects of hunger on test animals. At the completion of the study, organ weights were recorded (1218).

After 17 months, survivors were subjected to fasting for 5 days, during which time water was provided ad lib, and the benzoic acid regimen was continued by oral intubation. Weight loss and mortality weight were recorded. Survivors at this time were fitted with a weight on their tail and left to swim in a water bath. The time until they sank of exhaustion was recorded (1218).

Mice fed benzoic acid had a higher mortality than did control animals after the final fasting period (50% to 12%). The weight loss of the benzoic acid-treated animals was 26% during fasting but only 17% in control animals. In addition, control animals regained lost weight almost twice as quickly as benzoic acid-dosed animals (1218).

Data were omitted to a major extent, on the long-term mouse experiment. Despite extensive testing regimen reported, there were no data provided on food consumption or on weight gain/loss as compared to controls. The major emphasis reported was the effect of stress on mice fed benzoic acid, and the results in effect, were that mice fed benzoic acid at the level of 40 mg/kg/day for 17 months responded to physiological stress to a much lesser degree than did controls.

Groups of mice were fed 0, 40, and 80 mg/kg/day of benzoic acid for periods of 3, 8, and 18 months. The following observations/determinations were made: observation of general condition, production of offspring, viability under experimental conditions, viability under stress, utilization of food and water, weight gain, body cooling tests, physical stress tests, CCl₄ and K₂HPO₄ tests, blood determinations, complement titer, leucocytic phagocytic activity, blood oxidase activity, blood alkalinity, blood ketone level, protein in urine, carcinogenicity, and histopathological observations (589).

Following are data on body weight, food and water uptake, viability and endurance of physical load in the 18 month study with mice (589).

Mice (80 mg/kg/day) Body Weight, Food and Water Uptake, Viability

	Absolute Gain		Relative Gain	Uptake/Day		Viability	
	<u>ln g</u>	<u>ln %</u>	<u>ln %</u>	<u>Food (g)</u>	<u>Water (ml)</u>	<u>Exp.</u>	<u>Fasti</u>
Control Males	16.57	199.39	109.7	2.33	3.67	60	3.86
Control Females	12.13	166.83	93.26	2.81	4.14	72	5.22
Benzoic Acid							
Males	11.28	124.52	80.87	2.57	3.85	68	4.4
Benzoic Acid							
Females	10.95	118.23	78.05	2.65	3.52	68	4.4

Mice (40 mg/kg/day) Endurance of Physical Load

Swimming Time in Minutes	Added Weight/Total Body Weight	
	5%	50%
Control Males	4.66	5.0
Control Females	5.17	5.5
Benzoic Acid Males	11.71	---
Benzoic Acid Females	16.33	---

Overall, benzoic acid exerted a negative effect on mice. Body weight and viability were negatively affected. Carcinogenic effects attributable to benzoic acid were noted. The detoxifying capacity of the liver for CCl₄ was lowered. After 18 months, mice examined had increased liver weights and enlarged spleens, ovaries, and lungs (589).

This study was reported in several other papers, none of which provided data sufficient to justify the conclusions reached. That is not to say, however, the justification does not exist. It simply is not reported.

Rats

Groups of 10 male and 10 female rats weighing 100-120 g, were fed 40 mg of benzoic acid/kg/day for 18 months. An undisclosed number of controls were provided. The benzoic acid was fed in a paste prior to the main feed; food and water were provided ad lib (1218).

Food and water consumption, weight gain, and effects of stress factors (fasting) were recorded. Blood determinations included: serum complement titer, phagocytic activity of leucocytes, serum ceruloplasmin, blood alkalinity, blood ketones, blood morphology, erythrocyte sedimentation rate, and C-reactive serum protein (1218).

After 18 months, surviving animals were fasted for 13 days, during which time benzoic acid regimen was continued by oral intubation, and water was provided ad lib. Weight loss, mortality rate, and rate of weight-recovery were recorded (1218).

Rats fed benzoic acid for 18 months developed tolerance to a lethal dose of the compound given terminally. In rats fed benzoic acid at the level of 40 mg/kg/day for 18 months, a massive dose of 4000 mg/kg of sodium benzoate resulted in only a 25% mortality; whereas, a dose of 3600 mg/kg of sodium benzoate resulted in a 100% mortality of control animals (1218).

Data were not reported for the most part. From the data included one can determine that the average daily food and water intake of male test rats was significantly lower than that of controls. Female test animals and controls differed little.

Groups of rats were fed 0, 40, and 80 mg/kg/day of benzoic acid for periods of 3, 8, and 18 months. The following observations/determinations were made. Observation of general condition, production of offspring, viability under experimental conditions, viability under stress, utilization of food and water, weight gain, body cooling and physical stress CCl₄ and K₂HPO₄ tests: blood determination, complement titer, leucocytic phagocytic activity, blood oxidase activity, blood alkalinity,

blood ketone level, protein in urine, carcinogenicity, and histopathological observations (589).

There seemed to be no effect on body weight and viability of rats over an 18 month period on a dosage regimen of benzoic acid at 80 mg/kg/day. No changes in either macro or microstructure of parenchymatous organs were noted in test rats. Rats fed benzoic acid at a dosage of 80 mg/kg/day for 18 months survived a challenge with a massive overdose of benzoic acid up to 4000-5000 mg/kg (589).

Seventy-five 5 week-old Wistar rats weighing 50-60 g, housed individually were separated into 2 groups and provided food and water ad lib. One group of 50 (20 female, 30 male) rats was fed benzoic acid at 1.5% level in their diet. The other group of 25 (12 female, 13 male) rats served as control (832).

During the first 5 months, animals were weighed weekly. After that period, weight determinations were made every 4 weeks. The experiment was continuing at the time of the report (18 months) (832).

The difference between the control animals and the animals fed 1.5% benzoate was an average of 10 g/animal at 60 days, 18 g/animal at 340 days, and 15 g/animal at 430 days. In all cases, animals fed 1.5% benzoic acid had a decreased food intake and suppressed growth (832).

In another experiment, Marquardt fed 20 male Wistar rats and 20 male Osborne-Mendel rats benzoic acid at a 1.5% level. Ten male Wistar and 10 male Osborne-Mendel rats were used as controls. Results were similar (824).

At a 1.5% level, benzoic acid is toxic (832).

Three groups of 40 (20 male, 20 female) Bayer-Elberfeld rats housed in pairs were fed benzoic acid at 0, 0.5, and 1.0% levels in the diet. For the first 8 weeks, a paired feeding technique was used, and after 8 weeks, food was provided ad lib. Water was provided ad lib at all times (670).

For the first 8 weeks, the animals were weighed weekly; after the first 8 weeks, the rats were weighed every 4 weeks. At the age of 11-12 weeks, males and females were paired and housed together for 14 days. If pregnancy did not result, this pairing was repeated 8 weeks later. A final mating took place on the 48th week. The offspring of these were carefully observed over 2 generations and were fed benzoic acid of 4 generations (670).

Protein efficiency (weight gain/g food protein) was calculated, Litter size (number and weight) was recorded and histological determinations were made on 4 generations (670).

No signs of toxicity appeared at either the 0.5% or at the 1.0% dosage level over an entire life span of the rat and over 4 generations. Benzoic acid at the 0.5% level actually increased the life-span significantly; some animals lived over 1000 days. One survived 1346 days on a 1% benzoic acid diet (670).

IV. Special Studies

Carcinogenic

One hundred and thirty-nine mice were divided into a test group of 90 and a control group of 49. All animals received a stock diet, the test animals having a .2% level of benzoic acid as a supplement. For three months the mice received benzoic acid or stock diet. This was followed by intraperitoneal inoculation with Ehrlich ascites carcinoma (1-1.25 x 10⁶ cells) (327).

Mice were weighed before injection and their abdominal volume measured. Measurements were made at intervals of four days from day of transplantation until death. The observation period was 53-66 days, after which time all surviving mice were sacrificed and autopsied (327).

The following table shows tumor incidence:

Substance	No. of Mice	Observation Period (Days)	No.	No. of Tumors %
Benzoic Acid	90	53	62	60.8
Control	49	66	16	32.6

Successful inoculation of tumors was more frequent in benzoic acid fed mice. In addition to this, carcinoma development was also more intensive and the survival time of these mice was the shortest (327).

SODIUM BENZOATE

Biological Data

I. Acute Toxicity

Substance	Animal	Sex & No.	Route	Dosage (mg/kg)	Meas.	Ref.
Sodium Benzoate	Rat (USC)	70 (M & F)	P.O.	2100	LD ₅₀	317
Sodium Benzoate	Rat (Sherman)	M & F	P.O.	3450	LD ₅₀	317
Sodium Benzoate	Rat (Sherman)	10 M, 10 F	P.O.	4070	LD ₅₀	1249

A negro male with marked yellow atrophy of the liver had a severe reaction on two occasions, approximately four hours after ingesting sodium benzoate, manifested by excruciating substernal pain, elevation of blood pressure, dyspnea, and orthopnea followed by shock. Three days after ingesting the second dose of sodium benzoate, the patient developed signs of systemic infection. The white blood count showed an absence of neutrophils, but a normal to increased number of basophils and eosinophils. The bone marrow showed arrest of maturation of the neutrophilic myeloid elements, but normal maturation of eosinophils and basophils. There was later a marked leucocytic response to a generalized septicemia; this response was indicative of a recovery of the bone marrow. The patient died two months after the first challenge with sodium benzoate of liver failure (681).

II. Short-Term Studies

Rats

Young male white rats were fed diets containing 0, 1.5, 2.0, 2.5, and 3.0% sodium benzoate. The increase in the weight of the rats receiving 1.5, 2.0, and 2.5% sodium benzoate diets was comparable to that of the control group. However, animals at the 3.0% level showed a distinct growth depression even though their food consumption was comparable to control. At this level, one-third of the rats died (477).

White fed a low-casein diet as a basal ration to rats and studied the effects of various compounds on animals receiving sodium benzoate. Weanling male rats, housed individually, were fed a low-casein diet ad lib. Each animal received a daily supplement of 400 mg of dried yeast. When the rats reached a body weight of 75-85 g, sodium benzoate was added as 5% of the diet, a dosage level previously found to be the minimum quantity necessary to produce marked growth inhibition. This regimen was continued for 3-6 weeks (1462).

The average daily weight gain of 115 control animals was 1.3 g/rat, and the average daily food consumption was 6.2 g/rat. The corresponding figures for 106 test animals were 0.0 g/rat for weight gain and 3.3 g/rat for food intake. The addition of sodium benzoate at the 5% level produced the desired stunting without any obvious signs of gross toxicity. Four rats were used as long-time controls and were permitted to ingest sodium benzoate at the 5% level for 23 weeks. During this time, no gross toxicity other than growth depression, was observed among all members, of the group; however, a rat was occasionally seen which could not tolerate

sodium benzoate at this level, data from these rats were not used (1462).

Rats fed 1947-2195 mg of sodium benzoate/kg/day for 3-6 weeks (and up to 23 weeks) exhibited a severe depression of the growth rate (1462).

Harshbarger fed 4 week-old white rats 0, 1, and 3% sodium benzoate for 4-5 weeks. A paired feeding technique was used with a modification so that a control animal was compared with 2 test animals. Eight triplicates (24 rats) were fed sodium benzoate at varying levels. In each triplicate, litter mates of the same sex were used. Sodium benzoate was administered as a paste in the diet, and water was provided ad lib (530).

In the first study, control animals were fed calcium lactate and test control diet was compared with 1% sodium benzoate. In the second study, this control diet was compared with 1% sodium benzoate. In the final study conducted by Harshberger, animals from the second study, including the control animals, were fed 3% sodium benzoate (530).

In the first study, sodium benzoate at the 3% level proved toxic. The amount of weight gain was much less than that of control, and 2 of 8 rats died before the test period was ended. In the second study, sodium benzoate at the 1% level had no effect on weight gain. In the final study, 3% sodium benzoate in the diet resulted in a more toxic effect for control animals that had not previously encountered it than it did for those animals encountering it previously at the 1% and 3% levels. This seems to be indicative of a developed resistance by rats to the toxic effect of sodium benzoate (530).

Deaths caused by sodium benzoate occurred 7 to 20 days after initiation of dosage. Animals living longer than 20 days exhibited an increasing resistance to its toxic effects (530).

In another short-term study, 10 Sherman rats (5 male, 5 female) were housed in groups of 5 of each sex at each dosage level and fed sodium benzoate at levels of 0, 16, and other levels (3) up to 1090 mg/kg/day for a period of 30 days. Food and water were provided ad lib. The diet for each cage was kept in a separate jar and was weighed before and again with the uneaten food after the 30 day test period (1249).

Increase in body weight (compared to controls), reduction in appetite, death, and micropathology of adrenals, upper intestine, kidney, liver, and spleen were noted (1249).

At a level of 1090 mg of sodium benzoate/kg/day for a period of 30 days, there were no toxic effects observed (1249).

Five groups of 10 young Sherman rats (5 male, 5 female) were fed sodium benzoate at the following percentages of the diet: 0, 1, 2, 4, and 8%. After 90 days, animals were sacrificed, and their tissues were examined for micropathologic changes. The following table shows the results (317):

Table IV

The results of the 90-day feeding tests on rats receiving diets containing different levels of sodium benzoate or a sodium benzoate-free control diet

Category	Sodium benzoate-free control diet	Diets containing sodium benzoate in %			
		1.0	2.0	4.0	8.0
Sodium benzoate dosage, g/kg/day	0.0	0.64	1.22	2.62	6.29
Diet consumed, g. rat/day	11.97	12.69	12.63	12.30	11.98
p for t-test	---	0.54	0.62	0.75	0.99
Average weight gain of surviving rats, g.	156.3	170.7	166.5	150.6	100.2
p for t-test	---	0.58	0.86	0.82	0.06
Liver weight, % body weight	3.17	3.61	2.97	3.12	4.46*
p for t-test	---	0.22	0.26	0.89	0.0005
Kidney weight, % body weight	0.64	0.64	0.65	0.70	0.90*
p for t-test	---	1.00	0.65	0.06	0.0001
Uninfected rats	9	9	10	8	8
Toxic deaths	0	0	0	0	4
Average number days to death	---	---	---	---	13.0
Sets of tissues examined from uninfected rats	9	9	10	8	7
Sets with major pathology	0	0	0	0	1
Sets with any pathology	0	1	1	1	7

* Results statistically significant as compared with controls

At the 8% level in the diet, sodium benzoate depressed the growth rate of surviving rats by one-third, though food consumption remained the same as that of control animals. The weights of both liver and kidneys of these rats were significantly higher than those of controls. Frequent pathologic lesions of the liver and kidneys were evident (317).

Sodium benzoate fed at the 4% level (and lower) seemed to have no harmful effect on the rats over a period of 90 days. Rats consumed, at the 4% level, sodium benzoate amounting to 2620 mg/kg/day for 90 days (317).

Thirty-six Sherman rats (18 male, 18 female), 23 days-old, were assigned randomly to 6 cages so that there were 6 male and 6 female rats at the following dosage levels of sodium benzoate: 0, 2 and 5%. The rats were given a basal diet and water ad lib for three days, after which they received their respective sodium benzoate diets for 28 days (317).

Initially, body weights were recorded, and animals were observed for any gross abnormalities. During the testing regimen, the rats were weighed individually twice a week and were inspected daily for signs of toxic response. Food consumption for each group was recorded weekly, and the daily intake of sodium benzoate was calculated using the average body weights for each group (374).

All animals receiving 5% sodium benzoate died during the first or second week after exhibiting hyperexcitability, urinary incontinence, and convulsive seizures. Apart from a slight weight depression significant for male rats, animals at the 2% level were similar to controls (374).

Sodium benzoate at levels of 5686 mg/kg/day for males and 7780 mg/kg/day for females was lethal within 14 days. At dosages of 2000 mg/kg/day for males and 2200 mg/kg/day for females, sodium benzoate showed a slight growth depression for males and no visible effect for females over a period of 28 days (374).

Twenty-eight young rats were fed sodium benzoate as a 5% component of the diet. Within 2 weeks, 19 animals died of benzoate poisoning. The remaining 9 rats died by the end of the 3rd week. A similar feeding test involving 5 adult rats resulted in the death of 4 of them within 4-5 weeks (670).

Two groups of 10 male 8 week old Wistar rats were fed a stock diet, and the test group was fed sodium benzoate as a 1.5% component (added as a 10% aqueous solution). After 4 weeks, a paprika puree containing 45 U_g of carotene per animal per day was added to the stock diet. After 6 weeks, half of the animals were killed and the remainder were killed after 8 weeks (725).

Growth was recorded and kidney and liver vitamin A was determined (725).

There appeared to be no significant effects of sodium benzoate at the 1.5% level. Vitamin A content of liver and kidneys was not significantly different from that of controls (725).

In another series, Kramer and Tarjan reported that sodium benzoate at the 3% level depressed growth. This effect was based on results of a period of adapting rats to a benzoate diet (725). Unfortunately, data provided were not sufficient to enable one to make a meaningful determination of the benzoate dosage at a mg/kg/day figure.

This report corroborates in essence the reports of Kieckebusch and Lang, Marquardt, and of Kreis, et al., concerning the effects of benzoic acid. That is, that at a level of approximately 1%, the benzoates are at maximum non-toxic level; higher than this, they result in decreased food intake, depressed growth, and toxic effects on test animals.

Dog

A dog weighing 3.5 kg was fasted for 24 hours and then given 1 g of sodium benzoate. In 30 minutes, the animal showed evidence of muscular weakness and nausea, lay quietly, and breathed in a laborious manner. This behavior continued for 6 hours. On the following day, the animal was given 4 g of sodium benzoate. The dog became very weak within an hour; breathing was labored; and, after several hard convulsions, the animal died 2 hours and 20 minutes after administration of the sodium benzoate. Therefore, a dosage of 1430 mg of sodium benzoate/kg over a 2 day period resulted in the death of the dog (801).

Two dogs were fed on dog biscuits and water for several weeks then fasted for 36 hours. One dog weighing 3.5 kg was fed 3.5 g of sodium benzoate (citric acid + hydrochloric acid added to convert the sodium salt into the acid form), the other dog weighing 4.25 kg was fed a control diet plus the same amount of citric acid + hydrochloric acid. The sodium benzoate-fed dog showed great muscular weakness and tremor after an hour; the control dog was unaffected. The same regimen was

repeated the second day, and the results were similar. The dog receiving 1000 mg of sodium benzoate/kg/day for 2 days exhibited prostration, stiffness of the muscles, and internal bleeding (801).

Man

Twenty-four individuals were observed in an experiment in which 12 received pure apple juice and 12 received juice containing 0.1% sodium benzoate. In comparison with those who received pure apple juice, men who drank the apple juice containing 0.1% sodium benzoate exhibited the following symptoms: burning taste, fullness in the head, headache, nervousness, nausea, vomiting, itching of the skin, unusual perspiration, constipation, decreased flow of urine, increased specific gravity of urine, and albuminuria. A liter of filtered cider containing 0.2-0.3% sodium benzoate (2-3 g) caused albuminuria within 3 hours in the largest and soundest individuals (801).

Lucas reports, however, that he has ingested as much as 6 g/day for 3 successive days without the slightest discomfort (801).

III. Long-Term Studies

None

IV. Special Studies

Teratogenic

Sprague-Dawley rats were injected intraperitoneally on gestation day 9-11 or 12-14 with 90 and 600 mg/kg sodium chloride as a control. Sodium benzoate at levels of 100, 315, and 1000 mg/kg was injected in the test animals. Fetal body weight was reduced from 5.25 g in control group to 4.56 g in test group dosed at 1000 mg/kg sodium benzoate. At this level, in utero deaths were increased by 12% and gross anomalies were observed (884).

BENZOIC ACID and SODIUM BENZOATE

Biochemical Aspects

I. Breakdown

No information available from sources obtained.

II. Absorption-Distribution

The absorption of sodium benzoate or benzoic acid from the gastrointestinal tract appears to be very rapid and complete (1064, 1168, 1169, 1170). The method of absorption is simple diffusion of the unionized molecules (1164, 1169, 1170).

III. Metabolism and Excretion

In an extensive study, Bridges et al. determined the metabolites, and their rates of excretion, of sodium benzoate in man and twenty other species of animals (195). The data obtained is presented in Table V (195).

Table V. Metabolites of ^{14}C benzoic acid in urine in various species

Sodium ^{14}C benzoate was administered orally as described in the text. The first 24 h urine (unless otherwise stated) of each animal was chromatographed on Whatman no. 1 paper (see Table I for solvents) and the paper scanned in a Packard radiochromatogram scanner. Where three or more animals were used the results are expressed as averages with ranges in parentheses. Where only one or two animals of a species were used the individual results are given. The amounts of the metabolites were estimated from the chromatogram scans as described in the text. M, male; F, female.

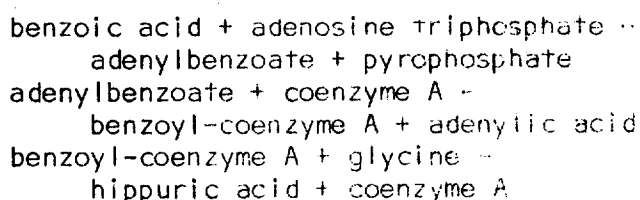
Species (no. and sex)	Family or other description	Dose		^{14}C excreted in 24 h (% of dose)	% of 24 h excretion found			
		Benzoic acid (mg/kg)	^{14}C ($\mu\text{Ci}/\text{animal}$)		Benzoic acid	Hippuric acid	Benzoyl glucuronide	Ornithuric acid
Primates								
Man (2M)	<i>Homo</i>	1	5.8	99.4, 99.7	0	100	0	0
Rhesus monkey (3F)	<i>Macaca</i>	20	6.8	47 (33-59)	0	100	0	0
Squirrel monkey (2F)	<i>Saimiri</i>	30	8.8	46, 49	14, 18	51, 53	5, Trace	0
Capuchin (1F)	<i>Cebus</i>	30	8.8	57	0	100	Trace	0
Artiodactyla								
Pig (large white) (2F)	<i>Suidae</i>	50	10.1	48, 51	15, 7	83, 93	Trace	0
Lagomorpha								
Rabbit (New Zealand White) (3F)	<i>Leporidae</i>	49	8.4	60 (36-77)	0	100	0	0
		200	9.7	89 (79-95)	Trace	98 (97-100)	2 (0-5)	0
Rodents								
Rat (Wistar albino) (3F)	<i>Muridae</i>	30	1.0	100 (95-102)	1 (Trace-2)	99 (97-100)	Trace	0
Mouse (I.C.L.) (3 \times 10F)*	<i>Muridae</i>	36	0.6	35 (43-67)	Trace	95 (94-96)	5 (4-6)	0
Guinea pig (English) (3F)	<i>Caviidae</i>	49	3.0	79 (63-94)	Trace	98 (97-99)	3 (2-3)	0
Hamster (golden) (3F)	<i>Cricetidae</i>	52	2.1	99 (98-101)	1	97 (97-98)	1 (1-2)	0
Lemming (steppe) (3F)	<i>Cricetidae</i>	56	2.3	98 (94-102)	Trace	100 (99-100)	0	0
Gerbil (3F)	<i>Cricetidae</i>	29	3.3	73 (66-82)	2 (0-4)	98 (96-100)	0	0
Carnivora								
Cat (mongrel) (2F)	<i>Felidae</i>	51	9.7	29, 86	Trace	100	0	0
Dog (mongrel) (2F, 1M)	<i>Canidae</i>	51	8.2	94 (87-100)	0	82 (71-100)	18 (Trace-25)	0
Ferret (mongrel) (3F)	<i>Mustelidae</i>	50	7.1	89 (37-90)	9 (0-12)	70 (67-72)	22 (21-22)	0
		198	7.5	78 (62-88)	9 (3-12)	47 (40-54)	44 (41-48)	0
		400	7.5	67 (56-74)	22 (21-23)	30 (24-37)	49 (42-53)	0
Insectivora								
Hedgehog (European) (2M)	<i>Erinaceidae</i>	50	6.4	67, 78	5, 7	76, 86	19, 7	0
Chiroptera								
Fruit bat (Indian) (2F)	<i>Pteropidae</i>	50	7.8	49, 54	12, 30	Trace	88, 70	0
Birds								
Chicken (Light Sussex) (5F)	<i>Phasianidae</i>	50	9.3	56 (38-69)	22 (16-28)	21 (10-43)	3 (0-8)	54 (40-68)
Pigeon (3F)	<i>Columbidae</i>	50	6.3	87 (84-102)	15 (13-20)	84 (80-87)	1 (Trace-3)	0
Reptiles								
Turtle (side-necked) (1)*	See footnote	50	6.2	39§	10	16	2	72
Gecko (1 \times 3F)¶	<i>Gekkonidae</i>	10	2.8	32	3	6	6	85

* The urines of ten animals were pooled for each determination.
 ‡ The urines of three animals were pooled.

* Also called hidden-necked turtle; sex not known; sub-order Pleurodira.
 § 96 h excretion. || 48 h excretion.

In most of the animals studied, hippuric acid is the major metabolite, with benzoyl glucuronide appearing as a secondary metabolite and benzoic acid sometimes appearing in its free form (195). However, in two cases (ferret and fruit bat) benzoyl glucuronide predominated, while in three other cases (chicken, turtle, and gecko) ornithuric acid appeared as the major metabolite (195). A large volume of literature by many researchers confirms the findings of Bridges.

In man, the main site of benzoate detoxication is the liver (1068, 1474), where conjugation of the benzoate with glycine takes place by the following mechanism (1474):



The formation of hippuric acid from sodium benzoate or benzoic acid has been found to be limited by the availability of glycine (21, 1064, 1474). The human body can produce about 0.62 g of glycine per hour (1056), which is enough to conjugate approximately 1.30 g of sodium benzoate or 1.5 g benzoic acid per hour (1068). When sodium benzoate or benzoic acid is administered to man, in the fasting state, in doses less than this it is excreted completely as hippuric acid (21, 195, 1064, 1474). If the dosage is greater than this, benzoyl glucuronide appears as a secondary metabolite (1064, 1474). The concurrent administration of glycine, or a substance which can be metabolized to form glycine, leads to an increased rate of hippuric acid formation (21, 680, 1064, 1474). Normal urinary excretion of hippuric acid in man is 1.0 - 2.5 g/day, which is equivalent to 0.8-2.0 g of sodium benzoate or 0.7-1.7 g of benzoic acid (1299). Quick found that the ingestion of sodium benzoate, when glycine is not a limiting factor, can increase this rate to approximately 46 g/day, calculated as sodium benzoate or 40 g/day, calculated as benzoic acid (1064). In a more recent study by Schachter, the maximum output of sodium benzoate in the form of hippuric acid was found to be 24 g/day and of benzoic acid 20 g/day (1166).

The elimination of sodium benzoate or benzoic acid is rapid, with 75-100% appearing in the urine in the first six hours after administration (680, 1064). Even after repeated doses (2 g NaOBZ/day or 1.7 g of the acid/day for 8 days), two or three days was sufficient for total elimination (155).

Experiments on the distribution and elimination of ^{14}C -benzoate in the rat have shown no accumulation of sodium benzoate or benzoic acid in the body (750).

IV. The Effects on Enzymes and Other Biochemical Parameters

The utilization of glycine in the detoxication of benzoate results in a reduction of the glycine level of the body (319, 1227). Therefore, the ingestion of benzoic acid or its salts effects any body function or metabolic process in which glycine is involved. For example, the ingestion of sodium benzoate leads to reduction in creatine (183), glutamine (527),

urea (1215, 1319), and uric acid (1067, 1319) formation due to preferential synthesis of glycine.

Benzoate accelerates the autoxidation of oxyhemoglobin (563, 671, 1383, 1463) and myoglobin (662) in vitro by interaction with the heme-protein. It also promotes the formation of green pigments through the oxidative disintegration of hemoglobin (563).

The administration of benzoic acid or sodium benzoate shortens prothrombin time, probably through increasing the level of thromboplastin cofactor (566).

The oral administration of sodium benzoate to rats decreased the rate of fat absorption (609), and altered the metabolism of lipids and electrolytes (723). As a result, decreases in the growth rate, the level of liver phospholipids and the potassium level of skeletal muscle were observed (723).

In vitro studies of guinea pig liver slices have also shown sodium benzoate inhibition of the oxidation of fatty acids (643, 644).

Bosund found that in vitro benzoate uncouples the oxidative phosphorylation from respiration in mitochondria (164). However, in similar experiments, Brody found no such effect (197).

Benzoic acid or sodium benzoate inhibits amino acid oxidases (687, 688, 714), alpha-chymotrypsin (580), glutamic acid decarboxylase (549), glycine acyltransferase (184), catalase (509) and lactic dehydrogenase (53). The Krebs's cycle is affected by benzoate through inhibition of alpha-ketoglutaric dehydrogenase and succinic dehydrogenase (651).

Intragastric administration of sodium benzoate or benzoic acid increased the tyrosine-alpha-ketoglutarate transaminase level in the rat (1232). Inhibition of this increase by injected puromycin and actinomycin D suggest that this effect of benzoate occurs through a mechanism involving increases in protein and RNA synthesis (1232).

V. Drug Interaction

Aspirin, acetylsalicylic acid, is metabolized in the body to form salicylic acid, which is then detoxified by conjugation with glycine. Concurrent administration of sodium benzoate depletes the supply of available glycine and thus increases the concentration and persistence of salicylic acid (21, 673, 772). The result of this is an increase in the teratogenic action of aspirin (673), salicylic acid having been implicated as the causative agent. By eating 1000 g, or about 2 lbs, of the right kinds of food a human being might consume as much as 1 g of sodium benzoate in a day. Levy et al. (772) demonstrated almost total inhibition of salicyluric acid formation in man using 3.2 g of sodium benzoate or 2.7 g benzoic acid. Since the body's capacity for making salicyluric acid is limited (771) a smaller dose of benzoate might have a similar effect.

The effect of the simultaneous administration of sodium benzoate with procaine, lidocaine, cocaine, tetracaine, or dibucaine was studied in surface anesthesia (rabbit cornea) and infiltrative anesthesia (rabbit tooth pulp). Sodium benzoate decreased the induction time and increased the potency and the duration of the effect of all the anesthetics to a significant extent (902).

The simultaneous administration of sodium benzoate with penicillin increases and prolongs the serum penicillin level by inhibition of renal excretion (143, 198, 1277). However, this occurs only with severe restriction of fluid and salt intake (143, 198, 1444).

In a toxicity study on rats and mice, the toxic effects of orally administered sodium benzoate and sodium bisulphite, when administered in combination, appeared to be synergistic or additive to some extent (1218).

It has also been reported that sodium chloride has a considerable synergistic effect with sodium benzoate (246).

Bubnoff et al. reported that orally administered benzoic acid exhibits an anticonvulsive effect in rats with cocaine-induced cramps (208).

VI. Consumer Exposure Information

Benzoic acid is most suitable for foods and beverages which naturally are in the pH range below 4.0 or 4.5 or can be brought into that range by acid addition. It is used in carbonated and still beverages, syrups, fruit salads, icings, jams, jellies, preserves, salted margarine, mince-meat, pickles and relishes, pie and pastry fillings, prepared salads and fruit cocktails. Use levels range from 0.05% to 0.10% (246).

The use of sodium benzoate or benzoic acid as a preservative in food and beverages is limited by law to one part per thousand (246).

A total of 72,703 pounds of benzoic acid and 2,274,835 pounds of sodium benzoate were used in foods in the United States in 1970 (943).

BENZOIC ACID

BIBLIOGRAPHY

(papers not referenced in monograph)

1. Abderhalden, E. and E. Gellhorn. 1922. Organic foodstuffs with specific action. *Arch. Ges. Physiol.* 195:1-2.
2. Abderhalden, E., and E. Wertheimer. 1924. Effect of nutrition upon the activity of definite internal secretion substances. *Arch. Ges. Physiol.* 206:451-9.
3. Abou-El-Makarem, M.M., P. Millburn, R.L. Smith, and R.T. Williams. 1966. The biliary excretion of foreign compounds in different species. *Biochem. J.* 99(1):3P.
4. Abou-El-Makarem, M.M., P. Millburn, R.L. Smith, and R.T. Williams. 1967a. Biliary excretion of foreign compounds. Benzene and its derivatives in the rat. *Biochem. J.* 105(3):1269-74.
5. Abou-El-Makarem, M. M., P. Millburn, R. L. Smith, and R. T. Williams. 1967b. Biliary excretion of foreign compounds. Species differences in biliary excretion. *Biochem. J.* 105(3):1289-1293.
6. Acheson, R.M., and S. Gibbard. 1962. The hydroxylation of benzoic acid by rats and guinea-pigs. *Biochim. et Biophys. Acta* 59(2):320-325.
7. Adamiya, G. P., and K. A. Dzhikuradze. 1962. Detoxication by the liver in brucellosis. *Tr. Tbilissk. Inst. Usoversh. Vrachei* 6:217-222.
8. Adamson, R.H., J.W. Bridges, and R.T. Williams. 1966. Metabolism of quinic acid and sulfadimethoxine in primates. *Biochem. J.* 100(3):71P.
9. Adler, F. F. 1946. Caffeine with sodium benzoate for acute alcoholism. *J. Am. Med. Assoc.* 130:530.
10. Aiso, K. 1967. Toxicity and safety of food additives. *Kagaku Kogyo* 18(2):1-5.
11. Aizawa, K. 1958. Influences of various substances on the absorption of sodium salicylate in the large intestine. *Nippon Yakurigaku Zasshi* 54:996-1021.
12. Akerboom, J., D. Melnick, and G.A. Perry. 1962. Food composition containing an auxiliary additive and a fungistat. U.S. Pat. 3,038,810.
13. Akiya, S., and U. Ariyosi. 1955. Body changes in rabbits caused by soluble methylhexabital. 1. Changes in the content of free glutamin and asparagin acid in the rabbit's brain. *Pharmac. Bull. (Tokyo)* 3:163-66.

14. Akutsu, T. 1929. Studies on the albuminuria in the experimental nephritis and the influence of purine derivatives upon it. *Proc. Imp. Acad. (Tokyo)* 5(8):390-392.
15. Alimowa, M.M. 1958. The hippuric acid content of one year old childrens' urine. *Vop. Med. Khim.* 4:280-284.
16. Allers, R. 1929. The possibility of a pharmacological analysis of the curve of work. *Arbeitsphysiol.* 2:241-247.
17. Alvarez, A. S. 1927. Preservation of cane and orange juice with sodium benzoate. *Rev. Ind. Agr. Tucuman* 18:35-37.
18. Alvarez Ullan, E. 1932. Danger of use of sodium benzoate as antiseptic to prevent fermentation of wines: advisability of preparing improved analytic method to determine its presence. *Rev. San. e Hig. Pub.* 7:607-610.
19. Amano, T., K. Kanomata, T. Takeuchi, and H. Yoshii. 1967. Preservative for shoyu (fermented soy sauce). VII. Determination of preservatives by gas chromatography. *Nippon Shokuhin Kogyo Gakkaishi* 14(11):499-503.
20. Amelung, H. 1933. Effect of preserving agents on the digestion of proteins. *Chem. -Ztg.* 57:614.
- * 21. Amsel, L.P. and G. Levy. 1969. Drug biotransformation interactions in man: II. A pharmacokinetic study of the simultaneous interactions in man: II. A pharmacokinetic study of the simultaneous conjugation of benzoic and salicylic acids with glycine. *J. Pharm. Sci.* 58(3):321-326.
22. Amsel, L. P., et al. 1970. Effect of ethanol on the conjugation of benzoate and salicylate with glycine in man. *Proc. Soc. Exp. Biol. Med.* 135:813-816.
23. Anand, J. C. 1960. Efficacy of sodium benzoate to control yeast fermentation in phalsa juice. *Indian J. Hort.* 17:138-141.
24. Anand, J. C., T. C. Soumithri, and D. S. Johar. 1958. The effectiveness of chemical food preservatives in preventing mold on Mango Squash. *Food Sci. (India)* 7:319-322.
25. Anand, J. C., T. C. Soumithri, and D. S. Johar. 1959. Prevention of fungal spoilage in mango pickle with chemical preservatives. *Indian J. Agr. Sci.* 29(2-3):181-184.
26. Ant-Wuorinen, O. 1935. Identification of saccharin and dulcin in beer. *Z. Untersuch. Lebensm.* 70:389-91.
27. Aoki, M., and Y. Isa. 1957. Must-protecting methods for drug preparations. II. Preservatives for liquid preparation. *Yakuzaigaku* 17:107-110.

28. Archinard, P. 1955. Estimation of salicylic and benzoic acid in wines by steam extraction. *Ann. Fals. Fraudes* 48:213-17.
29. Arihood, S., and R.J. Light. 1966. Inhibition of 6-methylsalicylic-acid synthesis in *Penicillium patulum*. *Nature (London)* 210:629-30.
30. Arima, K., T. Uozumi, and M. Takahashi. 1965. Autolysis of *Aspergillus oryzae*. I. Conditions of autolysis. *Agr. Biol. Chem. (Tokyo)* 29(11):1033-1041.
31. Armijo Valenzuela, M. de, and M. Izquierdo. 1958. Modifications produced in the toxicity index of dihydrostreptomycin by association with other substances. *Arch. Inst. Farmacol. Exp. (Madrid)* 10:121-134.
32. Arneus, T. 1934. Determination of taste threshold with nipakombin and sodium benzoate to comparatively determine the suitability of these substances as preservatives of raw food. *Upsala Laekarefoeren. Foerhandl.* 39(3/4):257-260.
33. Arneus, T. 1934. Determinations of threshold of taste of nipakombin and sodium benzoate, in order to establish comparative fitness of these substances as agents for preservation of raw foods. *Nord. Med. Tidskr.* 7:276-277.
34. Arneus, T. 1935. Determinations of taste threshold with nipakombin and sodium benzoate to comparatively determine the suitability of these substances as preservatives of raw foods. *Obst- U. Gemuese-Verwertg. Ind.* 22:514-515.
35. Arnstein, H. R. V. 1951. Metabolism of D- and L-serin in the rat. *Biochemic. J.* 49:439-446.
36. Asao, Y. and T. Yokotsuka. 1961. Flavor substances in soy sauce. Isolation of C₇H₁₂O₅ compound in soy sauce, and its structure. *Nippon Nogei Kagaku Kaishi* 35:831-7.
37. Aschehoug, V. 1960. The manufacture of fish preservatives. *Tidsskr. Hermetikind.* 46:117-26.
38. Asselineau, J. 1953. A study of the chemical structure of a mycolic acid isolated from the human strain R1 of *Mycobacterium tuberculosis*. *Bull. Soc. Chim. France* 1953(4):427-431.
- * 39. Association of Official Agricultural Chemists. 1965. Preservatives and artificial sweeteners. Pages 450-471 in A.O.A.C., Official methods of analysis of the A.O.A.C. A.O.A.C., Washington, D.C.
40. Astvatsatur'yan, A.T. 1961. Investigation of caffeine-sodium benzoate and caffeine-sodium salicylate by distributive paper chromatography. *Apteknoe Delo* 10(1):21-4.
41. Atkinson, J.N. 1936. Chemical analysis of food determination of benzoic acid. *J. Roy. Army M. Corps* 66:84-93.

42. Atzeni, L., and P. Giannessi. 1959. Color reaction of the fermentation inhibitor D3 and chromatographic detection of the benzoic acid fermentation inhibitor next to D3. *Ann. Stz. Chim.-Agrar. Sperim. Roma* 3, Pubbl. Nr. 159:108-13; *Ann. Chimica* 50:108-13, 1960.
43. Aurousseau, M. 1960. Comparative study of the in vitro cell toxicity of several isosteric benzol and thiophen derivatives. *Ann. Pharmac. Franc.* 18:309-19.
44. Austen, K.F. and W.E. Brocklehurst. 1961. Anaphylaxis in chopped guinea pig lung. I. Effect of peptidase substrates and inhibitors. *J. Exptl. Med.* 113:521-39.
45. Avigan, J., J.H. Quastel, and P.G. Scholefield. 1955. Studies of fatty acid oxidation. 3. The effects of acyl-CoA complexes on fatty acid oxidation. *Biochem. J.* 60(2):329-334.
46. Avramov, N. 1954. The joint influence of stimulants and hypnotics with parasympathicomimetic action upon the gastric secretion. *Nauch. Trudove Visshya Med. Inst. "Vulko Tservenkov"* 2(2):63-84.
47. Baars, J.K. 1934. Use of salicylic acid and benzoic acid in the Dutch Indies for the preparation of lemonades and syrups. *Meded. Dienst Volksgezondh. Nederl.-Indie* 23:128-35.
48. Baba, S., A. Matsuda, and Y. Nagase. 1969. Analysis of drugs by use of radioisotopes. V. Identification of metabolites of ephedrine in the rabbit liver. *Yakugaku Zasshi* 89(6):833-6.
49. Bachoffer, C.S., and Q.L. Hartwig. 1956. Relation of structural configuration to protection against X-irradiation. *Radiation Res.* 5(5):528-541.
50. Baetsle, G. 1969. Water and water supply in the soft drinks industry. *Fermentatio* 65(6):253-268.
51. Baettig, K., and E. Grandjean. 1955. Effect of Barbitalum soluble and of Coffeinum-sodium benzoate on a conditioned reflex in the rat. *Helv. Physiol. Pharmacol. Acta* 13(4):54-55.
52. Bak, T.G., and S. Kuwano. 1962. Reversible and irreversible inhibitions of glutamic and arginine decarboxylase activities of *Escherichia coli* by gallic acid and D-catechol. *Chem. Pharm. Bull. (Tokyo)* 10:833-41.
- * 53. Baker, B. R., W. W. Lee, W. A. Skinner, A. P. Martinez, and E. Tong. 1961. Potential anticancer agents. 50. Non-classical antimetabolites. 2. Some factors in the design of exo-alkylating enzyme inhibitors, particularly of lactic dehydrogenase. *J. Med. Pharmac. Chem.* 2(6):633-657, 1960.
54. Baker, B.R., T.J. Schwan, J. Novotny, and B.T. Ho. 1966. Analogs of tetrahydrofolic acid. XXXII. Hydrophobic bonding to dihydrofolic reductase. 4. Inhibition by para substituted benzoic and benzoyl-L-glutamic acids. *J. Pharm. Sci.* 55(3):295-302.
55. Balatasouras, G.D., and N.G. Polymenacos. 1963. Chemical preservatives as inhibitors of yeast growth. *J. Food Sci.* 28(3):267-275.

56. Baldinger, L.H., and J.A. Nieuwland. 1933. The relation of some physical properties to bactericidal action of some alpha-phenyl-substituted acids. *J. Am. Pharm. Assocn.* 22:711-16.
57. Balduf, S. 1964. Attempts at killing *Salmonellae* in duck egg compounds; addition of ammonia, benzoic acid, p-hydroxybenzoic acid--ethyl ester and sorbic acid. *Z. Ges. Hyg.* 10:496-503.
58. Baldwin, B.C., D. Robinson, and R.T. Williams. 1958. Glucuronide formation in hens. *Biochem. J.* 68:22P-23P.
59. Baldwin, B.C., D. Robinson, and R.T. Williams. 1959. Detoxication. LXXVIII. Glucuronide and ethereal sulfate formation in hens. *Biochem. J.* 71:638-42.
60. Baldwin, B.C., D. Robinson, and R.T. Williams. 1960. Studies in detoxication. 82. The fate of benzoic acid in some domestic and other birds. *Biochem. J.* 76(3):595-600.
61. Balough, L., S. Z. Donhoffer, G. Y. Mestyan, T. Pap, and I. Toth. 1952. The effect of Na benzoate, Na p-aminobenzoate, Na salicylate, Na p-aminosalicylate and salicylic acid amide on the O₂ consumption and the body temperature of the rat. *Kiserletes Orvostudomány* 4:184-189.
62. Baltaceano, G., and G. Nicholesco. 1931. Experimental studies of choleric substances. *Arch. Mal. App. Digest. Mal. Nutrition* 21(2):182-202.
63. Bandelin, F.J. 1958. The effect of pH on the efficiency of various mold-inhibiting compounds. *J. Am. Pharm. Assoc.* 47:691-4.
64. Banerjee, S. 1947. The effect of certain substances on the prevention of the diabetogenic action of alloxan. *Science* 106:128-30.
65. Barbour, R.G.H., and J.M. Vincent. 1950. Bacteriostatic action of phenol, benzoic acid, and related compounds on *Bacterium aerogenes*. *J. Gen. Microbiol.* 4:110-21.
66. Barbour, R. G. H. 1959. The adsorption of *Aerobacter aerogenes* of p-hydroxybenzoic acid and its esters and of sodium benzoate at different pH levels. *Australian J. Biol. Sci.* 12(2):204-212.
67. Barker, D. 1967. Myotatic and kinesthetic mechanisms. The innervations of mammalian skeletal muscle. *Ciba Found Symp.* 3-19.
68. Barnabas, J. 1954. Identification of phenols by circular paper chromatography. *Naturwissenschaften* 41:453-4.
69. Baro, J.C. 1943. New microchemical reactions of benzoic and picric acids. *Univ. Nacl. Litoral (Rosario, Argentina)* 7:47-52.
70. Barrett, F. 1970. Extending the keeping quality of bakery products. *Bakers' Digest* 44(4):48-49, 67.

71. Bartmann, K. 1953. Studies on desensitization to *Neurospora crassa* mushroom poison. *Naunyn-Schmiedeberg's Arch. Exp. Pathol. Pharmacol.* 218:327-34.
72. Baruffini, A. 1958. Conservation of tragacanth gels. *Farmaco (Pavia) Ed. Prat.* 13:380-2.
73. Basevi, A. 1958. Action of intravenous sodium benzoate on the glycine level of blood in normal individuals and liver patients. *Boll. e Mem. Soc. Trieneta Med. Interna* 5:125-135.
74. Basilisco, L. 1933. Chemical, physical-chemical and biological studies of the esters of p-oxybenzoic acid. *Atti R. Accad. Fisiocrit. Siena* 1(4, Studi Fac. Med.):297-320.
75. Bastianutti, J., and B. Romani. 1960. Chromatographic identification of antiseptics in wines. *Boll. Lab. Chim. Provinc.* 11:362-67.
76. Bastrom, H., and B. Mansson. 1955. The action of salicylates and related compounds on the sulfate exchange of chondroitinsulfuric acid. *J. Pharm. Pharmacol.* 7:185-90.
77. Bauer, K. 1923. Effect of diuretica on bacteria. *Zentralblatt F. Bakter. u. Parasitenk. I. Abt.* 90:42-48.
78. Baum, F., and H. Lamm. 1959. Testing of means of preserving by an agar-diffusion (hole) test. *Ernaehrungsforschung* 4:84-9.
79. Baum, F., and H. Lamm. 1963. Nonspecific detection of preservatives in various foods. *Ernaehrungsforschung* 8(3):355-61.
80. Baum, F., and C. Wardsack. 1961. Germination test for the nonspecific detection of preservatives. *Ernaehrungsforschung* 6:584-95.
81. Baumgaertner, H. 1957. The action of epsilon-caprolactam on certain microorganisms. *Ernaehrungsforschung* 2:733-40.
82. Bausch, H. 1949. Pest control and disinfection with new preparations and methods. *Brauerei* 3:217-218, 222, 226.
83. Becka, J. 1936. Study on the assimilation conditions of minerals in animal organisms. III. Influence of sodium compounds on calcium excretion by the kidney and intestine. *Sbornik Ceskoslov. Akad. Zemedelkse* 11:60-67.
84. Beckett, A.H., R.M. Camp, and H.W. Martin. 1952. Application of titration in nonaqueous media to pharmaceutical analysis. I. Determination of alkali metal salts of aliphatic and aromatic acids. *J. Pharm. Pharmacol.* 4:399-406.
85. Beckett, A. H., and A.C. Moffat. 1968. Influence of alkyl substitution in acids on their performance on the buccal absorption test. *J. Pharm. Pharmacol.* 20 (Supl.):239-47.
86. Beech, F.W., and J.G. Carr. 1955. A survey of inhibitory compounds for the separation of yeasts and bacteria in apple juices and ciders. *J. Gen. Microbiol.* 12:85-94.

87. Behre, A. 1951. The keeping quality of Bismarck herrings. *Z. Lebensm. -Untersuch. u.- Forsch.* 93:17-30.
88. Beiglboeck, W., and R. Kahle. 1955. The effect of pantothenic acid on the hippuric acid test. *Klin. Wochschr.* 33:1056-1057.
89. Bell, T. A., J. L. Etchells. 1952. Sugar and acid tolerance of spoilage yeasts from sweet-cucumber pickles. *Food Technol.* 6(12):468-472.
90. Bellet, S., L. J. Feinberg, H. Sandberg, and M. Hirabayashi. 1968. The effects of caffeine on free fatty acids and blood coagulation parameters of dogs. *J. Pharmacol. Exp. Ther.* 159(2):250-254.
91. Bellet, S., A. Kershbaum, E. M. Finck. 1968. Response of free fatty acids to coffee and caffeine. *Metab., Clin. Exp.* 17(8):702-707.
92. Bellet, S., L. R. Roman, H. Sandberg, and J. B. Kostis. 1970. The effect of nicotinic acid on the caffeine-induced serum free fatty acid increase. *J. Pharmacol. Exp. Ther.* 175(2):348-351.
93. Benard, H., A. Gajdos, and M. Gajdos-Toeroek. 1950. Origin of hyperprotophyria of red blood cells in the rabbit after injection of vitamin B12. *C. R. Seances Soc. Biol. Filiales* 144:1488-1490.
94. Bendien, W. M., J. Neuberg, and I. Snapper. 1932. A contribution to the theory of the sedimentation velocity of the red blood cells. *Biochem. Z.* 247:306-321.
95. Benediktov, I. I. 1965. Aspects of muscle mitochondria structure and oxidative activity in *Ascaris suum*. *Mitokhondrii, Strukt. Funkts., Mater. Simp., Moscow* 60-2.
96. Benger, H. 1969. Conservation agents and preservatives in citrus fruits. *Zbl. Bakt.* 210:263-7.
97. Bentley, R., C.M. Springer, V.G. Ramsey, G. H. Dialameh, and R.E. Olson. 1968. Coenzyme Q. The origin of the carbon methyl group and its point of attachment to the aromatic precursor. *J. Biol. Chem.* 243(1):174-7.
98. Benton, D.A., A.E. Harper, M.E. Winje, and C.A. Elvehjem. 1955. Compounds other than threonine that affect fat deposition in the livers of rats fed low protein diets. *J. Biol. Chem.* 214(2):677-684.
99. Benz, G. 1950. The use of sweet must powder (microbin and other benzoates) for the preservation of fruit and grape must. *Deut. Nahrungsmitt.- Rundschau* 82-83.
100. Bergel, F., and R. C. Bray. 1956. Stabilization of xanthine oxidase activity by salicylate. *Nature* 178:88-89.
101. Bergner, H. 1968. Formation of hippuric acid and detoxication of benzoic acid in growing rats depending on protein nutrition. *Arch. Tierernaehr.* 18(2):83-95.

102. Bernhard, K. 1937. Metabolism studies on the dehydration of the cyclohexane ring. Hoppe-Seyler's Z. Physiol. Chem. 248:256-76.
103. Bernhard, K., J.P. Vuilleumier, and G. Brubacher. 1955. The formation of benzoic acid in the animal body. Helv. Chim. Acta. 38:1438-44.
104. Bernhard, K., and J. Vuilleumier. 1952. Origin of benzoic acid in urine. Helv. Physiol. et Pharmacol. Acta 10:C47-8.
105. Bernheim, F. 1941. The effect of various substances of the oxygen uptake of the tubercle bacillus. J. Bact. 41:387-95.
106. Bernheim, F. 1942. Oxidation of benzoic acid and related substances by certain Mycobacteria. J. Biol. Chem. 143:383-389.
107. Bernheim, F. 1953. The influence of substituted benzoic acids on the adaptive enzyme formation of a mycobacterium. J. Biol. Chem. 203:775-80.
108. Bernheim, F. 1957. Effect of copper ions and certain thioureas on enzymes induction and ammonia assimilation in a Mycobacterium. J. Pharmacol. Exptl. Therap. 119:93-98.
109. Bernheim, F., and W.E. DeTurk. 1951. The effect of certain drugs on nitrogen assimilation in Pseudomonas aeruginosa. J. Pharmacol. Exptl. Therap 103(2):107-114.
110. Bertolani, F. 1950. Blood level and urinary excretion of p-aminosalicylic acid after administration of substances with delaying action. Rass. Fisiopatol. Clin. e Terap. (Pisa) 22:43-62.
111. Bertolani, F., and M. Farinetti. 1948. Variations in blood sodium salicylate after oral administration of sodium benzoate. Boll. Soc. Ital. Biol. Sper. 24:1150-1152.
112. Bertolani, F., and M. Farinetti. 1949. Behavior of the metabolism of p-aminosalicylic acid after administration of certain drugs with retarding action. I. Action of sodium benzoate on concentration of p-aminosalicylic acid in blood and urine. Boll. Soc. Ital. Biol. Sper. 25:796-800.
113. Bertolani, F., E. Mari and G. Lusiani. 1952. The action of aromatic compounds in the benzol group on the sedimentation rate of erythrocytes. Arch. Scienze Med. 93(77):303-24.
114. Betts, J.J., H.G. Bray, W.V. Thorpe, and K. White. 1955. Kinetic studies of the metabolism of foreign organic compounds. VII. Toluic acids and N-tolylureas. Biochem. J. 61:4-11.
115. Beveridge, E.G. and W.B. Hugo. 1964. The resistance of gallic acid and its alkylesters to bacteria which can degrade aromatic ring structures. J. Appl. Bacteriol. 27:304-11.

116. Bhat, M.G., T. Ramakrishnan, and J.V. Bhat. 1959. Salicylate as intermediate in the breakdown of aromatic ring by *Pseudomonas convexa* var. *hippuricum*. *Canadian J. Microbiol.* 5(1):109-118.
117. Bhatia, B. S., N. S. Kapur, and G. S. Siddappa. 1958. Browning in some preserved fruit products. *Food Sci.* 7:251-252.
118. Bhatia, B. S., N. S. Kapur, and G. S. Siddappa. 1959. Studies on the non-enzymatic browning of some fruit juices and pulps. *Food Sci. (India)* 8:347-350.
119. Bhatia, B. S., L. V. L. Sastry, G. V. Krishnamurthy, K. G. Nair, and G. Lal. 1961. Preserving the fruit pulp of *Annona squamosa*. *J. Sci. Food Agr.* 12:529-532.
120. Bhramaramba, A., and S. Mahboob. 1963. Indian cinnamon leaf oil. *Perfumery Essent. Oil Record* 54:30-2.
121. Bignami, G., and L. Boraccia. 1924. Investigations on hippuric synthesis in human organism. *Boll. Soc. Med. Chir. di Pavia* 36:121-37.
122. Biener, J., E. Costiner, and L. Vaisler. 1960. Influence of insulin on hepatic glucuronide conjugation capacity. *Acad. Rep. Populare Romine, Inst. Endocrinol.* "Prof. C. I. Parhon," *Studii Cercetari Endocrinol.* 11:695-697.
123. Biener, J., E. Costiner, and L. Vaisler. 1961. Studies on the excretion of benzoic and p-hydrobenzoic acid in the form of glucuronic acid conjugate products in the gall. *Comun. Acad. Republ. Populare Romine* 11:137-42.
124. Biermann, G. 1932a. Preservative action of benzoic acid on meat. *Ztschr. Fleisch. Milchhyg.* 43:21-29.
125. Biermann, G. 1932b. Preservative action of benzoic acid on meat. *Ztschr. Fleisch. Milchhyg.* 43:41-45.
126. Biermann, G. 1933. The preservative action of benzoic acid. *Z. Fleisch. Milchhyg.* 43:305-07.
127. Bieter, R. N., and A. D. Hirschfelder. 1922. The effect of sodium benzoate and sodium hippurate, and other drugs on the glomerular circulation in the frog. *Proc. Soc. Exptl. Biol. Med.* 19:352-353.
128. Biggs, P. R., S. Rodebosch. 1963, 1964. Preservatives for cut flowers and fruits. *Brit. Pat.* 939,932 and *U. S. Pat.* 3,122,432; *South African Prior.* Feb. 12, 1960.
129. Bignami, G. 1924a. Hippuric acid synthesis in the human organism. II. Behavior of glucuronic acid in the urine after administration of sodium benzoate. *Boll. Soc. Med. Chir. Pavia* 36:509-520.
130. Bignami, G. 1924b. Hippuric acid synthesis in the human organism. III. The behavior of diuresis after excretion of sodium benzoate. *Boll. D. Soc. Med.-Chirurg. Pavia* 36:531-545.

131. Bignami, G., and L. Boracchia. 1924. Hippuric acid synthesis in the human organism. *Boll. D. Soc. Med.-chirurg. Di Pavia* 36:121-138.
132. Bisaro, A., and M. Butto. 1952. Toxicity, epigastric pain due to intravenous injections of sodium benzoate. *Friuli Med.* 7:245-260.
133. Bito, T. 1952. Antiseptics of fish paste. *Bull. Nagoya Inst. Technol.* 4:218-227.
134. Binova, E.S. and R.L. Raigorodska. 1934. Detection and determination of salicylic and benzoic acids and their salts. *Farm. Zhur.* 30-4.
135. Bizzi, A., A. M. Codegoni, and S. Garattini. 1964. Salicylate, a powerful inhibitor of free fatty acid release. *Nature* 204(4964):1205.
136. Bizzi, A., S. Garattini, and E. Veneroni. 1965. The action of salicylate in reducing plasma free fatty acids and its pharmacological consequences. *Brit. J. Pharmacol.* 25(1):187-96.
137. Blackmore, K. E., and H. Schnieden. 1957. Diuretics on the water excretion of protein deficient rats. *Brit. J. Pharmacol.* 12:279-283.
138. Blake, M., and L. E. Harris. 1952. Influence of dissolving intermediary on the solubility of xanthine derivatives in water. I. Distribution of theophylline and caffeine. *J. Am. Pharmac. Assoc. Sci. Edit.* 41:521-523.
139. Bleyer, B., W. Diemair, and K. Leonard. 1933. The influence of preservatives on enzymatic processes. *Arch. Pharmaz. Ber. Dtsch. Pharmaz. Ges.* 271:539-52.
140. Boehm, E., and H. Jeglinski. 1928. Preserving action of nipagin and its homologs on pharmaceutical preparations. *Pharm. Ztg.* 73:480-1.
141. Boerngen, S., K. Gebler, F. Hauschild. 1960. Proposals for DAB 7. Part I. Methylene blue, benzoic acid, sodium benzoate. *Pharmazie* 15:17-9.
- * 142. Boger, W.P., and R.M. Baker. 1947. A comparison of effects of caronamide and benzoic acid on penicillin plasma concentration. *Proc. Soc. Exptl. Biol. Med.* 66:1-4.
- * 143. Bohls, S. W., E. B. M. Cook, and R. T. Potter. 1946. Oral and parenteral use of aluminum penicillin mixtures in the treatment of gonorrhea. *J. Ven. Dis. Int.* 27:69-74.
144. Bohnsack, H. 1967a. Essential oils, perfumes, and flavorings. XVIII. Components of Bourbon vanilla beans. *Riechst., Aromen, Koerperpflegem.* 17(4):133-5.
145. Bohnsack, H. 1967b. Essential oils, scented and flavored substances. XX. Experiments on natural raspberry fruit oils. 3. Analysis of raspberry residue oil extracts. *Riechst., Aromen, Koerperpflegem.* 17(12):514-16.

146. Boissio, M. L. 1959. The action of medicinals on the activity of purified alpha-amylase from *Hordeum tetrastichum* and swine pancreas. *Ann. Chimica* 49:358-366.
147. Bojankiewicz, M. 1964. Detection of preservatives by a fermentation test. *Roczniki Pantswowego Zakladu Hig.* 15(2):167-70.
148. Bokorny, T. 1921. Behavior of hippuric acid, benzoic acid and benzol compounds toward yeast. *Allg. Brauer-Hopfenztg.* 21/12:1413-14; 22/12:1417-18; 23/12:1421-22.
149. Bolliger, A. 1928. The influence of the purine diuretics on inorganic phosphates of blood and urine. *J. Biol. Chem.* 76:797-807.
150. Bomar, M. 1961. Viability of microorganisms on microbicidal wrapping paper. *Prumysl Potravin* 12:564-568.
151. Bomar, M. 1962a. Determination of the action of fungi toxic substances based on the inhibition of Mycel growth. *Folia Microbiol. (Praha)* 7:185-90.
152. Bomar, M. 1962b. Mode of action of fungitoxic compounds on microorganisms. II. Synergism of the bactericidal effect of certain Chemical preservatives and low temperatures. *Folia Microbiol. (Prague)* 7:298-305.
153. Bonnevie, P. 1936. Experimental study of the antimycotic effect of ethyl p-hydroxybenzoate and allied substances. *Acta Dermato-Venereologica* 17:576.
154. Bordas, F. 1926. Benzoic acid and benzoates in wine making. *Chimie & Industrie Special No.* 629.
- * 155. Bordas, Francois-Dainville, and Roussel. 1925. The elimination of benzoic acid and of benzoates. *Compt. Rend.* 181:304-306.
156. Borgstroem, B. 1949. Detoxification of benzoic acid by glucuronic acid under normal conditions and in liver disease. *Acta. Med. Scand.* 133(1):7-18.
157. Borgstroem, G. 1950. Keeping fish fresh in Scandinavian and other lands. *Kaelietechnik* 2:106-112.
158. Bornand, M. 1925. The antiseptic action of salicylic and benzoic acids and of paper impregnated with salicylic acid against molds. *Tech. Ind. Schweiz. Chem.-Ztg.* 239-41.
159. Bornkessel, S., L. Kny, and J. Richter. 1960. Proposals for the DAB 7, Part 10. Benzoic acid, boric acid. *Pharm. Zentralhalle Deutsch.* 99:195-7.
160. Borsalino-Semeria, A. M. 1933. The action of sodium benzoate on solutions of injectable pepsin. *Biochim. Terap. Sper.* 20:553-561.
161. Bossak, H. N., and W. P. Duncan. 1958. Method of stabilizing antigen emulsion used in VDRL syphilis tests. *Public Health Repts.* 73:836-838.

162. Bostrom, H., K. Berntsen, and M. W. Whitehouse. 1964. Biochemical properties of anti-inflammatory drugs. II. Effects on sulfate-35 S metabolism in vivo. *Biochem. Pharmacol.* 13(3):413-420.
163. Bostrom, H., and B. Mansson. 1955. The action of salicylates and related compounds on the sulfur exchange of chondriotin sulferic acid. *J. Pharm. Pharmacol.* 7:185-190.
- * 164. Bosund, I. 1957. The effect of salicylic acid, benzoic acid and some of their derivatives on oxidative phosphorylation. *Acta Chem. Scand.* 11(3):541-544.
165. Bosund, I. 1959. The bacteriostatic action of benzoic acid and salicyl acid. I. The effect on the oxication of glucose and pyrunic acid through protus vulgaris. *Acta Chem. Scand.* 13:803-813.
166. Bosund, I. 1960a. The bacteriostatic action of benzoic acid and salicylic acid. 3. The effect on the pyruvate and acetate oxidation through different organisms. *Acta Chem. Scand.* 14:1231-1242.
167. Bosund, I. 1960b. The bacteriostatic action of benzoic and salicylic acids. V. Influence of pH on the total uptake of benzoic acid by proteus vulgaris and baker's yeast. *Physiol. Plantarum.* 13(4):793-799.
168. Bosund, I., I. Erichsen, and N. Molin. 1960c. The bacteriostatic action of benzoic and salicylic acids. VI. Influence of amino acids and related substances on the growth inhibition. *Physiol. Plantarum.* 13(4):800-811.
169. Bosund, I. 1960d. The bacteriostatic action of benzoic and salicylic acids. VII. Effect on acetate metabolism and formation of adaptive enzymes in pseudomonas fluorescens. *Physiol. Plantarum.* 13(4):812-821.
170. Bosund, I. 1960e. The bacteriostatic action of benzoic and salicylic acids. II. The effect on acetate metabolism. *Acta Chem. Scand.* 14(1):111-125.
171. Bosund, I. 1960f. The bacteriostatic action of benzoic and salicylic acids. III. The effect on pyruvate and acetate oxidation by different organisms. *Acta Chem. Scand.* 14(6):1231-1242.
172. Bosund, I. 1960g. The bacteriostatic action of benzoic and salicylic acids. IV. The effect on oxidation of TCA cycle intermediates, lactate and gluconate. *Acta Chem. Scand.* 14(6):1243-1252.
173. Bosund, I. 1962. The effect of benzoic and salicylic acid on the metabolism of microorganisms. *Advances Food Res.* 11:331-353.
174. Bousser, R. 1951. Preserving of organic materials. *Fr. Pat.* 994,471.
175. Bowen, J. F., C. C. Strachan, and C. W. Davis. 1953. Effect of preservatives on fermentation spoilage in pickled cherries. *Food Technol.* 7:102-105.

176. Boyce, E. B. 1945. Report on (the determination of) benzoate of soda and esters of benzoic acid (in foods). J. Assoc. Official Agr. Chem. 28:301-302.
177. Boyles, F. M. 1951. Chocolate drink. U.S. Pat. 2,556,792, June 12.
178. Bozal, J., and F. Calvet. 1960. Inhibitory action of several substances on chymotrypsin digestion. An. Real. Soc. Espan. Fisica Quim., Ser. B. 56:803-810.
179. Bradford, L. W., and J. W. Brackett. 1958. Systematic procedure for the identification of dangerous drugs, poisons, and narcotics by ultraviolet spectrophotometry. Mikrochim. Acta 353-382.
180. Brachfeld, B. A. 1969. Antimicrobial food additives. Bakers' Digest 43(5):60-62, 65.
181. Brakefield, J. L., and C. L. A. Schmidt. 1924. Formation of hippuric acid by icteric animals. Proc. Soc. Exp. Biol. Med. 21:206. Ber. Ges. Physiol. 25:455-456.
182. Brakefield, J. L. 1927. Detoxication of benzoic acid in man. J. Biol. Chem. 74:783-785.
- * 183. Brand, E., and M. M. Harris. 1933. Some aspects of intermediary protein metabolism. Science 77(2007):589-590.
- * 184. Brandt, I. K. 1966. Glycine acyltransferase activity in developing rat liver. Biochem. Pharmacol. 15:994-995.
185. Brannen, M., and M. A. Forbes, Jr. 1966. Salicylate sensitivity. Texas State J. Med. 62(3):58-60.
186. Braunsdorf, K. 1963. Candied fruits and marmalades prepared with combined preservatives. Nahrung 7(1):79-85.
187. Bray, H. G., F. C. Neale, and W. V. Thorpe. 1946. Fate of certain organic acids and amides in the rabbit. 1. Benzoic and phenylacetic acids and their amides. Biochem. J. 40:134-139.
188. Bray, H. G., W. V. Thorpe, and K. White. 1950. The fate of certain organic acids and amides in the rabbit. 10. The application of paper chromatography to metabolic studies of hydroxybenzoic acids and amides. Biochem. J. 46(3):271-275.
189. Bray, H. G., W. V. Thorpe, and K. White. 1950. Kinetic studies on metabolism of organic compounds. Biochem. J. 47:XIII.
190. Bray, H. G., W. V. Thorpe, and K. White. 1951. Kinetic studies of the metabolism of foreign organic compounds. 1. The formation of benzoic acid from benzamide, toluene, benzyl alcohol and benzaldehyde and its conjugation with glycine and glucuronic acid in the rabbit. Biochem. J. 48(1):88-96.
191. Bray, H. G., W. V. Thorpe, and K. White. 1952. Kinetic studies of the metabolism of foreign organic compounds. V. A mathematical model expressing the metabolic fate of phenols, benzoic acids and their precursors. Biochem. J. 52(3):423-430.

192. Bremer, J. 1955. The conjugation of glycine with cholic acid and benzoic acid in rat liver homogenate. 21. Gallic acids and steroids. *Acta Chem. Scand.* 9:268-271.
193. Brewer, R. K., and M. S. Dooley. 1935. Influencing body temperature through sodium salts of some aromatic acids.
194. Bridges, R. L., et al. 1969. Separation of benzoic acid from volatile fatty acids using Sephadex G-10. *J. Chromatogr.* 39:519-520.
- * 195. Bridges, J. W., M. R. French, R. L. Smith, and R. T. Williams. 1970. The fate of benzoic acid in various species. *Biochem. J.* 118(1):47-51.
196. Briscoe, M. 1924. Sodium benzoate as a food preservative. *Chem. Age (London)* 10:160-161.
- * 197. Brody, T. M. 1956. Action of sodium salicylate and related compounds on tissue metabolism in vitro. *J. Pharmacol. Exptl. Therap.* 117(1):39-51.
- * 198. Bronfenbrenner, J., and C. B. Favour. 1945. Increasing and prolonging blood penicillin concentrations following intramuscular administration. *Science* 101(2635):673-674.
199. Brooks, M. M. 1923. New quantitative observations on the penetration of acids and alkalide carbonates in live and dead cells. *Proc. Soc. Exp. Biol. Med.* 20:384-385.
200. Brooks, R. O. 1925. Notes on the benzoating of cider. *Am. Vinegar Ind.* 4(5):13.
201. Broseta, P. Cunata. 1968. The chemistry and technology of grape juice. *Sem. Vitivinic.* 23(1.144-1.145):2.433, 2.434, 2.437, 2.439, 2.441, 2.443, 2.445.
202. Brown, W. T., and P. G. Scholefield. 1954. Studies of fatty acid oxidation. I. Oxidation of the alkylthio fatty acids. *Biochem. J.* 58:368-374.
203. Brshewskaja, O. N., K. M. Lwow, and O. Ss. Nedelina. 1964. Free radicals in fermentative hydrolysis of adenosintriphosphates. *Biofizika (USSR)* 9:500-501.
204. Brunelle, R. L., and G. E. Martin. 1963. Quantitative determination of benzaldehyde in flavors by gas-liquid chromatography. *J. Assoc. Off. Agr. Chemists* 46(6):950-951.
205. Brunnengraeber, C., and O. Elsner. 1921. Manufacturing process of a preservative made from benzoic acid. *Ger. Pat.* 337,494, Kl. 53c, May 31.
206. Bruno, S. 1963. Gas chromatography as a test method in a study on preservative additives found together in foods. *Ind. Conserve.* 38:125-126.
207. Bryan, A. W. 1925. Clinical and experimental studies on sodium benzoate. *J. Clin. Invest.* 2:1-33.

- * 208. Bubnoff, M. v., D. Schnell, and J. Vogt-Moykoff. 1957. Concerning the pharmacology of benzoic acid, parachlorobenzoic acid, as well as parahydroxybenzoic acid and its esters. *Arzneimittel-Forsch.* 7(6):340-344.
- 209. Bubon, N. T., and V. K. Yashchenko. 1966. Use of flame photometry in analysis of drugs containing sodium. III. *Aptech. Delo* 15(5):46-49.
- 210. Bucci, F., and A. M. Cusmano. 1961. Analytic reactions of benzoic acid based on nitration and reduction. *Rend. Ist. Super. Sanita.* 24(9):664-675.
- 211. Buergi, S. 1945. Acceleration, inhibition, and disorganization of spontaneous rhythmic arterial contractions. *Helv. Physiol. Pharmacol. Acta* 3:215-229.
- * 212. Buglio, B. 1968. Note on determination of sodium benzoate in the presence of sorbate salts. *J. Assoc. Offic. Anal. Chem.* 51(6):1278-1279.
- 213. Bukhman, N. D. 1939. Determination of benzoic acid in foodstuffs. *Voprosy Pitaniya.* 8(6):102-109.
- 214. Bulankin, I. N., N. O. Nagorna, E. V. Parina, and A. M. Timkovits'ka. 1955. The mechanism of gel formation in acid-base denaturation. *Ukrain. Biokhim. Zhur.* 27:267-274.
- 215. Bullowa, J. G. M., and C. P. Sherwin. 1922. Can fasting fowls synthesize glycocoll or ornithine? *Proc. Soc. Exptl. Biol. Med.* 20:125-128.
- 216. Burakowski, T., J. Cieplinski, and J. Derecki. 1966. Removal of cesium-137 from meat. *Med. Weterynar. (Poland)* 22(3):133-136.
- 217. Burgess, K. E. 1920. Toxicity of diluted sodium benzoate-containing phenol solutions for staphylococci. *J. Physical Chem.* 24:738-740.
- 218. Burmeister, H. 1958a. Conservation of fruit juices. *Branntweinwirtschaft* 80:523-526.
- 219. Burmeister, H. 1958b. The preserving of fruit juices. *Ind. Obst- u. Gemueseverwert.* 43:364-367.
- 220. Burton, D. E., K. Clarke, and G. W. Gray. 1965. Mechanism of the antibacterial action of phenols and salicylaldehydes. 3. Substituted benzaldehyde. *J. Chem. Soc. (London).* 2458-2460.
- 221. Buttiaux, R. 1948. Viscous deterioration of sucrose solutions by *Leuconostoc mesenteroides* and means of preventing it. 7th Congr. Intern. Ind. Agr., Paris I, Pt. 2:13. Sugar Ind. Abstracts. 10(8):91-92.
- 222. Byrum, W. R., and J. L. Lichtin. 1952. The influence of several drugs upon the acute toxicity of gold sodium thiosulfate. *J. Am. Pharm. Assoc.* 41:105-107.

223. Calabrese, S. 1941. The effect of sodium benzoate on blood composition. Experimental researches. *Pathologica* 33:293-298.
224. Calvărano, I. 1964. Detection of antifermentatives in lemon and orange juices by thin layer chromatography. *Essenze Deriv. Agrumari*. 34(3):137-143.
225. Calvi, L. A. 1955. Quick test and oxido-reductive processes in progressive muscular dystrophy. *Minerva Pediat.* 7:866-871.
226. Capuano, L. 1952. Mohler's reaction. *Rev. Fac. Sci. Univ. Istanbul*. 17A:114-137.
227. Carpenter, A. M. 1955. Candida. II. Sensitivity tests on strains of Candida. *Antibiotics & Chemotherapy*. 5:255-262. *Am. J. Clin. Pathol.* 25:98.
228. Carr, E. A., Jr. 1960. A comparative study of inhibition of penicillinase by simple compounds, antiserum, and their combinations. *Antibiotics Ann.* 1950-60:161-168.
229. Casida, J. E. 1955. Toxicity of aromatic acids to the larvae of the mosquito *Aedes aegypti* L. and the counteracting influence of amino acids. *Biochem. J.* 59(2):216-221.
230. Castan, P. 1924. Effect of benzoic acid on yeasts. *Compt. Rend. Soc. Phys. Hist. Nat. Geneve*. 41:141-142.
231. Cats, H., and H. Onrust. 1958. Identifying food preservatives by paper chromatography. *Chem. Weekblad*. 54:456-459.
232. Caughey, W. S., J. D. Smiley, and L. Hellerman. 1957. L-glutamic acid dehydrogenase: Structural requirements for substrate competition: Effect of thyroxine. *J. Biol. Chem.* 224(1):591-607.
233. Caujolle, F., and D. Meynier. 1958. The toxicity of phthalic acids. *Compt. Rend.* 246:851-852.
234. Cerkasov, D. P. 1959. Determination of antitoxic function of the liver by means of synthesis of hippuric acid after injection of sodium benzoate in highly productive chicks. *Sbornik Ceskoslov. Akad. Zemedelskych Ved, Veterin. Med.* 4(32):97-104.
235. Cervinka, M. 1969. Phenolic compounds in barley. *Kvasny Prumysl.* 15(2):38-40.
236. Chakraborty, J., and J. N. Smith. 1967. Enzymic oxidation of some alkylbenzenes in insects and vertebrates. *Biochem. J.* 102:498-503.
237. Chakrayarti, S. N., K. R. Ganguly, and R. D. Sarma. 1941. An ideal preservative for suspected washes (mashes). *Current Sci.* 10:207-211.

238. Chantrenne, H. 1951. The requirement for coenzyme A in the enzymatic synthesis of hippuric acid. *J. Biol. Chem.* 189(1):227-233.
239. Chapman, A. C. 1927. The examination of foodstuffs for preservatives. *A. Caution. Analyst.* 52:215-217.
240. Charley, V. L. S. 1937. Studies on fruit products. XI. Fruit syrup manufacture. A. Extraction and preservative methods for fruit juices in syrup manufacture. B. Effect of the sugar concentration on aroma preservation in syrups. C. Preserving of syrups by heat and chemical treatment. *Annu. Rep. Agric. Hortic. Res. Stat.* Long Ashton Bristol. 195-230.
241. Charley, V. L. S. 1939. Studies on fruit products. XI. Fruit syrup manufacture. A. Extraction and preservative methods for fruit juices in syrup manufacture. B. Effect of the sugar concentration on aroma preservation in syrups. C. Preserving of syrups by heat and chemical treatment. *Fruit Prod. J. Amer. Vinegar Ind.* 18:133-137, 167-168, 185-187.
242. Chauvet, P. 1925. Detection of benzoic acid in white wines. *Ann. Fals.* 18:31-33.
243. Chelle, J. L. 1925. Salicylic and benzoic acids in normal wines. *Ann. Fals.* 18:134-148.
244. Cheo, P. C., and A. C. Tarjan. 1955. Use of anti-fermentative chemicals for maintaining cultures of *Panagrellus redivivus* for nematocide screening. *Plant Dis. Reporter* 39(5):405-406.
245. Cheramy, P., and E. Cliche. 1938. Erythrocyte-plasma partition of organic medicaments. *J. Pharm. Chim.* 27:321-324.
- * 246. Chichester, D. F., and F. W. Tanner, Jr. 1968. Antimicrobial food additives. Pages 137-207 in T. E. Furia, ed. *Handbook of food additives*. Chemical Rubber Co., Cleveland.
247. Chmielnicka, J. 1967. Cabbage peroxidase. VII. Effect of preservatives on the peroxidative and oxidative activities. *Acta Pol. Pharm.* 24(4):419-426. (Pol.).
248. Chodorowska, K. 1955. Determination of benzoic acid added to foods. *Roczniki Panstwowego Zakladu Hig.* 6:329-343.
249. Christensen, H. N., P. F. Cooper, Jr., R. D. Johnson, and E. L. Lynch. 1947. Glycine and alanine concentrations of body fluids; experimental modification. *J. Biol. Chem.* 168(1):191-196.
250. Christensen, H. N., J. A. Streicher, and R. L. Elbinger. 1948. Effect of feeding individual amino acids upon the distribution of other amino acids between cells and extra-cellular fluid. *J. Biol. Chem.* 172:515-524.
251. Clague, J. A., and C. R. Fellers. 1934. Relation of benzoic acid content and other constituents of cranberries to keeping quality. *Plant Physiol.* 9(3):631-636.

252. Clark, L. C., Jr., R. P. Fox, R. Morin, and F. Benington. 1956. Effect of psychotomimetic compounds on certain oxidative and hydrolytic enzymes in mammalian brain. *J. Nervous Mental Disease* 124:466-472.
253. Clemens, W. 1955. Paper chromatographic studies on some preservatives. *Fette, Seifen, Anstrichmittel* 57:109-111.
254. Clingman, A. L., and D. A. Sutton. 1952. Separation of benzenecarboxylic acids by paper chromatography. *Fuel* 31:259-260.
255. Collett, M. E. 1921. The toxicity of acids to infusoria. II. The role of molecule and of ions. *J. Exptl. Zool.* 34:67-74.
256. Collett, M. E., and M. F. Clarke. 1929. On the question of the specificity of intracellular dehydrogenases. II. Dehydrogenase of frog and fish muscles. *J. Biol. Chemistry* 82:429-433.
257. Colombo, E. 1968. Determination of benzoic acid in non-alcoholic beverages: limitations of official analytical method for almond and orzate soft drinks. *Rivista Italiana Essenze, Profumi, Piante Officinali, Aromi, Saponi, Cosmetici*. 50(11):597-600.
258. Comar, O. B., P. Pescione, and T. Reda. 1962. Antiseptic action of solutions for dissolving kidney stones and their effects upon the activity of antibiotics in vitro. *Urol. Intern.* 14:54-63.
259. Cooper, I. S., E. H. Ryneerson, C. S. MacCarty, and M. H. Power. 1950. Metabolic consequences of spinal cord injury. *J. Clin. Endocrinol.* 10(8):858-870.
260. Copius-Peereboom, J. W., and H. W. Beekes. 1964. Thin-layer chromatography of preservatives. *J. Chromatogr. (Amsterdam)* 14:417-423.
261. Cornut, S. 1951. Bacteriological investigation of antiseptics in beer. *Fermentatio* 16-17.
262. Cortelezzi, J. 1929. Critical study of the method of Ter Meulen-Heslinga. *Rev. Facultad Cienc. Quim.* 6(1):7-14.
263. Cottle, W. H., and A. T. Veress. 1966. Urinary excretion of glucuronides by cold-acclimated rats. *Can. J. Physiol. Pharmacol.* 44(2):325-326.
264. Couceiro, M. L., and B. Regueiro. 1962. Relations among ascorbic acid, chemical preservatives, and microorganisms. *Anales Bromatol. (Madrid)* 14(4):263-314.
265. Couceiro, M. L., and B. Regueiro. 1964. Microbiological studies on some chemical food preservatives. *Anales Bromatol. (Madrid)* 16(3):329-366.
266. Covello, M., and O. Schettino. 1964a. Use of thin-layer chromatography in the study of antifermentative studies in foods. *Thin-layer Chromatogr., Proc. Sympos., Ist. Superiore Sanita, Rome*. 1963:215-219.

267. Covello, M., and O. Schettino. 1964b. The determination of fungistatic agents in food products by thin-layer chromatography. III. Quantitative determination. *Riv. Ital. Sostanze Grasse* 41(7):337-342.
268. Crawford, S. L., and J. M. Ward. 1934. Constituents of commercial vinegar made from apple wine and apple products. *Fruit Prod. J. Am. Vinegar Ind.* 13:48-51, 83-84, 107-108, 169-171, 174, 187.
269. Cremer, H. 1934. Influence of preservatives in vitamin deficient animals. *Z. Unters. Lebensmittel* 67:205.
270. Cronheim, G., J. S. King, Jr., and N. Hyder. 1952. Effect of salicylic acid and similar compounds on the adrenal-pituitary system. *Proc. Soc. Exptl. Biol. Med.* 80:51-55.
271. Crowde, J. H., and C. P. Sherwin. 1923. Synthesis of amino acids in animals. *J. Am. Chem. Soc.* 44:618.
272. Crowther, E. H. 1940. Sodium benzoate-sodium chloride-coated wrappers. *Can. Chem. Process Inds.* 24:505, 521.
273. Cruess, W. V. 1931. The relation of pH value and preservative action. *Fruit Prod. J. Am. Vinegar Ind.* 10(8):242-244.
274. Cruess, W. V. 1932a. Hydrogen-ion concentration in preservation. *Ind. Eng. Chem.* 24:648-649.
275. Cruess, W. V. 1932b. The role of acidity in food preservation. *Food Manuf.* 7:176-178, 181.
276. Cruess, W. V., and J. H. Irish. 1931. The role of free acids in the preservation of fruit specialties by sodium benzoate. *Fruit Prod. J. Am. Vinegar Ind.* 10:177.
277. Cruess, W. V., and P. H. Richert. 1929. Effect of hydrogen ion concentration on the toxicity of sodium benzoate to microorganisms. *J. Bact.* 17(5):363-371.
278. Cruess, W. V., P. H. Richert, and J. H. Irish. 1931. The effect of hydrogen-ion concentration on the toxicity of several preservatives to microorganisms. *Hilgardia* 6(10):295-314.
279. Csiszar, J., and A. Bakos. 1941. The determination of benzoic acid in process cheese. *Milch. Forsch.* 21:56-61.
280. Csonka, F. A. 1924. Animal calorimetry; administration of various proteins with benzoic acid to a pig. *J. Biol. Chem.* 60:545-582.
281. Cultrera, R. 1933. Determination of benzoic, salicylic, cinnamic and saccharic acids, and of the esters of p-hydroxybenzoic acid. *Ind. Ital. Conserve Aliment.* 8:298-301.
282. Cuny, L., and D. Quivy. 1942. Antiheparin action of nicotinic acid in vitro. *Compt. Rend. Soc. Biol.* 136:707-708.
283. Curli, G. 1937. Observations on rancidity degree and the effect of foreign substances on it. *Ann. Chim. Applicata.* 27:519-523.

284. Curli, G. 1955. Influence of extraneous substances of butter on the reaction of Tortelli-Jaffe. *Latte* 29:537-538.
285. Cuzzoni, M. T. 1964. Quick detection of preservatives of bromatologic interest. *Farmaco (Pavia), Ediz. Prat.* 19:323-326.
286. Daels, F. 1921. Detection and quantitative determination of preservatives in foodstuffs. *J. Pharm. Belg.* 3:273-274.
287. Daels, F. 1928. Benzoic and salicylic acids in alcoholic beverages. *Bull. Acad. Med. Belg.* 1:28. *Quart. J. Pharm. Pharmacol.* 2:83.
288. Dagley, S., M. E. Fewster, and F. C. Happold. 1952. Bacterial oxidation of phenyl acetic acid. *J. Bacteriol.* 63:327-336.
289. Dagley, S., A. Rodgers. 1953. The citric acid cycle and the bacterial oxidation of aromatic acids. *J. Bacteriol.* 66:620.
290. Dagley, S., W. C. Evans, and D. W. Ribbons. 1960. New reaction pathways in oxidative metabolism of aromatic compounds in microorganisms. *Nature (London)* 188:560-566.
291. Daniels, T. C., and R. E. Lyons. 1931. The physical properties of phenyl-substitute acid solutions in relation to their bactericidal action. *J. Physical Chem.* 35:2049-2060.
292. D'Arca Simonetti, A., and M. Talenti. 1960. Identification of nonvolatile antifermentative substances in wine. *Igiene Sanita Pubblica (Rome)* 16(5-6):282-297.
293. Darmon, P. 1957. Biological testing for antiseptics in wines. *Mises Point Chim. Anal. Pure Appl. Anal. Bromatol.* 5:33-47.
294. Date Y. 1958. The action of certain drugs on the coronary flow of the dog. *Igaku Kenkyu* 28:1193-1209.
295. Dauksas, K., and M. Finkelsteinaite. 1959. Conductometric determination of organic acids. *Vilniaus Univ. Mokslo Darbai, Chem.* 28(1):23-28.
- * 296. Davidek, J., A. Kedzierska, and G. Janicek. 1966. Polarographic determination of benzoic acid. *Z. Lebensm.-untersuch. -Forsch.* 129(6):370-373.
297. Davies, D. R., and T. P. E. Hughes, 1940. Faulty detoxication in mental disorder. *Lancet* 1:403-405.
298. Davy, E. D. 1921. Determination of sodium benzoate in oleomargarine. *J. Am. Pharm. Assoc.* 10:458.
299. Dean, J. A., and C. Cain, Jr. 1955. Titration of acids in dimethyl-formamide using high frequency. *Anal. Chem.* 27:212-214.
300. De Blasi, D. 1926. Vitamins and food preservatives. *Annali d'Igiene* 36:709-715.

301. DeCastro, O. A. P., H. Sandberg, L. J. Feinberg, and S. Bellet. 1969. Effects of various routes of caffeine administration on oral and intravenous glucose tolerance tests in dogs. *Metab., Clin. Exp.* 18(2):163-171.
302. De'Conno, E., E. Goffredi, and C. Dragoni. 1925. Oil preservatives. *Annali Chim. Appl.* 15:475-484.
303. De Francesco, F., and G. Margheri. 1961. Detection of additives in foods by ultraviolet spectrophotometry. I. Preservatives in wines and marmalades. *Boll. Lab. Chim. Provinciali (Bologna)*. 12:5-11.
304. De Greef, J. A., and C. F. Van Sumere. 1966. Effect of phenolic aldehydes, phenolic acids, coumarins, and related compounds on the growth of *Saccharomyces cerevisiae*. *Arch. Int. Physiol. Biochem.* 74(3):512-513.
305. Dehut, V. 1933. Antiseptics in chocolate and sugar product factories. *Bull. Officiel Office Int. Fabricants Chocolat Cacao*. 3:59-63.
306. De Kok, A., and C. Veeger. 1968. L-Amino-acid oxidase. I. Effects of pH and competitive inhibitors. *Biochim. Biophys. Acta* 167(1):35-47.
307. Delaunay, A., and C. de Roquefeuil. 1954a. The effect of sodium salicylate and related compounds on normal and immune blood serums. *Rev. Immunol.* 18:230-251.
308. Delaunay, A., and C. de Roquefeuil. 1954b. Modification by salicylates of the kinetics of antigen-antibody precipitation reactions. *Compt. Rend. Soc. Biol.* 148:990-992.
309. Delaunay, A., and C. de Roquefeuil. 1955. Study of anaphylactic shock in the guinea pig. Modification of the sensitizing power of horse serum by chemical treatment (action of sodium salicylate, salicylic derivatives, urea, guanidine, formaldehyde, etc.). *Rev. Immunol.* 19:27-45.
310. Delmont, L.-R., and J.-A. Burnier. 1950. Preparation of inedible meat. *Fr. Pat.* 954,873.
311. Delprat, G. D., and G. H. Whipple. 1921. Studies on liver function. Benzoate injection and hippuric acid synthesis. *J. Biol. Chem.* 47:229-246.
312. De Moura, J., and H. C. Dostal. 1965. Nonvolatile acids of prunes. *J. Agr. Food Chem.* 13(5):433-435.
313. De Navarre, M. G. 1954. Interference between some nonionics and certain preservatives. *Congr. Mondial Detergence et Prods. Tensioactifs, 1st Congr., Paris*. 2:741-742.
314. De Navarre, M. G., and H. E. Bailey. 1956. The interference of nonionic emulsifiers with preservatives. II. *J. Soc. Cosmetic Chemists* 7:427-433.
315. De Navarre, M. G. 1957. The interference of nonionic emulsifiers with preservatives. III. *J. Soc. Cosmetic Chemists* 8:68-75.

316. Deshusses, J. 1946. Mohler's test for benzoic acid. *Pharm. Acta. Helv.* 21:183-186.
- * 317. Deuel, H. J., Jr., R. Alfin-Slater, C. S. Weil, and H. F. Smyth, Jr. 1954. Sorbic acid as a fungistatic agent for foods. I. Harmlessness of sorbic acid as a dietary component. *Food Research* 19:1-12.
318. Deuticke, B., and E. Gerlach. 1967. Effect of hemolysins, benzene derivatives and pharmacologically active substances on the form and phosphate permeability of human erythrocytes. *Klin. Wochenschr.* 45(19):77-83.
- * 319. De Vries, A., and B. Alexander. 1948. Studies on amino acid metabolism. III. Plasma glycine concentration and hippuric acid formation following ingestion of benzoate. *J. Clin. Invest.* 27(5):665-668.
320. Diack, S. L., and H. B. Lewis. 1928. Studies on hippuric acid synthesis in animals. VII. A comparison of hippuric acid after sodium benzoate, benzylalcohol and succinic acid benzyl ester intake. *J. Biol. Chem.* 77:89-95.
321. Dickens, F., and J. Pearson. 1951. Microestimation of benzoic and hippuric acids in biologic material. *Biochem. J.* 48:216-221.
322. Dickes, G. J. 1965. The determination of some food additives by thin-layer chromatography. *J. Assoc. Public Analysts.* 3(4):118-123.
323. Diemair, W., H. Riffart, and E. Schmelck. 1938. Determination of p-hydroxybenzoic acid and its ester in foods. *Mikrochemie* 25:247-255.
324. Di Giacomo, A., and G. Rispoli. 1960. Variation of carotenoid content in orange juice during fruit ripening and preservation of the juice. *Conserva e Deriv. Agrumari (Palermo)* 9:171-175.
325. Dikstein, S., D. Hirshbein, and F. G. Sulman. 1963. The melanophoric reaction. *Israel J. Chem.* 1:181-182.
326. Dimitrov, N. V., J. Miller, and S. R. Ziegra. 1969. Effects of caffeine on glucose metabolism of polymorphonuclear leukocytes. *J. Pharmacol. Exp. Ther.* 168(2):240-243.
- * 327. Dinerman, A. A., and A. D. Ignat'ev. 1966. Effect of certain food preservatives on the development of tumors in mice. *Gig. Sanit.* 31(9):38-42.
328. Dingemans, J. J. J. 1930. Detection of benzoic acid in jams, fruit juices and margarine. *Chem. Weekbl.* 27:640.
329. Dluzniewski, A. 1961. Experimental investigations of the action of caronamide, benzoic acid and amidopyrine on the cells of the main renal tubules and some other organs (liver, lungs, spleen and testicles) in white mice. *Folia Med. Cracoviensia* 3(1):3-63.

330. Dluzniewski, A. 1963. Experimental studies on the influence of caronamide (K), benzoic acid (KB) and amidopyrine (A) on athrocytosis of the cells of the main renal tubule and athrocytosis of several other organs (liver, lungs, spleen, testes) in white mice. II. Trypan blue in the urine, blood serum, liver and kidneys after administration of caronamide, benzoic acid and amidopyrine. *Dissert. Pharmaceut.* 15(2):107-115.
331. Do, J. Y., and D. K. Salunkhe. 1964. Effects of chemical treatments on refrigerated apple juice. *Food Technol.* 18(4):182-185.
332. Donbrow, M., and Z. A. Jan. 1965. Molecular interactions of caffeine with benzoic acid, o- and p-methoxybenzoic acids, and o- and p-nitrobenzoic acids. *J. Pharm. Pharmacol., Suppl.* 17:129S-137S.
333. Dostal, J. 1962. Preserving foods, pharmaceuticals and cosmetic products. *Australian Pat.* 239,132, July 19.
334. Douglas, J. F. 1965. Metabolism destiny of benzyl-N-benzylcarb-ethoxyhydroxamate (W-398). *J. Pharmacol. Exp. Therapeut.* 150:105-108.
335. Dragas, R. 1938. Detection of benzoic acid in wine and grape must. *Jb. Oenol. Stat. Ackerbauminist. Jugoslaw.* 2:217-223.
336. Dresse, A., J. Lecomte, and P. Fischer. 1960. Sensitization to catechol amines by derivatives of benzoic acid. *Compt. Rend. Soc. Biol.* 154:2144-2146.
337. Drews, E. 1953. Detection of organic acids and preservatives with paper chromatography. *Getreide Mehl* 3:85-88.
338. Drews E. 1955a. Paper chromatography of bread and baked goods. II. Determination of volatile acids. *Brot Gebaeck* 9:45-47.
339. Drews, E. 1955b. Paper chromatic studies on bread and baked goods. 3. Detection of preservatives in bread. *Brot Gebaeck* 9:81-84.
340. Drews, E. 1958. Further possibilities of the use of paper chromatography in the bakery sector. *Brot Gebaeck* 12:138-140.
341. Dring, L. G., R. L. Smith, and R. T. Williams. 1966. Fate of amphetamines in man and other mammals. *J. Pharm. Pharmacol.* 18:402-405.
342. Druckrey, H. 1957. Health protection by food additives. Report on the international development, the conferences in Rome in 1956 and Ascona in 1957.
343. Dryden, E. C., and C. H. Hills. 1959. Taste thresholds for sodium benzoate and sodium sorbate in apple cider. *Food Technol.* 13(2):84-86.
344. Dubaquier, J. 1925. Detection of benzoic acid in wines. *Ann. Fals.* 18:149-150.
345. Duckworth, H. W., and J. E. Coleman. 1970. Physiochemical and kinetic properties of mushroom tyrosinase. *J. Biol. Chem.* 245(7):1613-1625.

346. Dudfield, R. 1923. Preservatives in foodstuffs. *Pharm. J.* 110:430.
347. Eastwood, T.M. 1944. Bacteriostatic and fungistatic action of some organic chemicals. *Science* 100:10-11.
- * 348. Edwards, F. W., H. R. Nanji, and M. K. Hassan. 1937. Determination of benzoic acid. *Analyst* 62:172-177.
349. Effersoe, P. 1951. Effect of sodium benzoate on the relation between inulin, creatinine, thiosulfate, and urea clearances in rabbits. *Acta Pharmacol. et Toxicol.* 7:5-15.
350. Egeberg, H.S. 1935. Keeping animal and vegetable substances fresh for nutrition purposes. *Ger. Pat.* 621,350 Kl. 53c (addition to *Ger. Pat.* 593,054), Nov. 6.
351. Eichler, H., G. Endres, G. Gminder, and J. Umbrecht. 1929. Use of benzoic acid and sodium benzoate as ingredients of fresh sausages and fresh minced meat. *Z. Untersuch. Lebensm.* 58:553-84.
352. Eijgelaar, G., and D.A.A. Mossel. 1959. Microbiological detection of preservatives besides benzoic and sorbic acid in margarine with a sodium chloride resistant yeast as test basis. *Analyst* 84:293-96.
353. Eisenbrand, J., A. Klauck, and D. Pfeil. 1958. Azo dyes as indicators for the detection of preservatives and related substances in microbiological experiments. *Naturwissenschaften* 43:519-20; *Chem. Zentr.* 129:1452-3.
354. Elbaum, S., and E. Jacobs. 1956. Effect of sodium benzoate injection on the rapid elimination of bromsulfonphthalein. *Acta Clin. Belg.* 11(4):319-322.
355. Eliseeva, A. M. 1957. Effects of some diuretics on the functioning of autotransplanted and reinnervated kidneys. *Farmakol. i Toksikol.* 20(4):57-60.
356. Elliott, T.H., R. C. C. Tao, and R.T. Williams. 1965. Stereochemical aspects of the metabolism of the isomeric methylcyclohexanols and methylcyclohexanones. *Biochem. J.* 95(1):59-69.
357. El-Masri, A.M., J.N. Smith, and R.T. Williams. 1958. Studies in detoxication. 75. Further observations on the metabolism of hydrazides of aromatic acids. *Biochem. J.* 68(4):587-592.
358. Endo, C. 1936. The effect of various chemicals on oxygen consumption by rabbit kidney. *Sei i-kai Med. J.* 55(7):1435-1451.
359. Englis, D.T., B.B. Burneet, R.A. Schreiber, and J.W. Miles. 1955. Determination of benzoic and salicylic acids in food products. *J. Agr. Food Chem.* 3:964-9.
360. English, E. 1959. A rapid method for the determination of benzoic acid in soft drinks. *Analyst* 84:465-6.

361. Ensminger, L.G. 1957. Analysis of vanilla extracts and imitations. J. Assoc. Offic. Agr. Chemists 40:423-33.
362. Entrekin, D. N. 1961. Relation of pH to preservative effectiveness. I., Acid media. J. Pharm. Sci. 50:743-746.
363. Epstein, S.S., I.B. Saporoschetz, M. Small, W. Park, and N. Mantel. 1965. Simple bioassay for antioxidants based on protection of *Tetrahymena pyriformis* from the photodynamic toxicity of benzo(a)pyrene. Nature 208(5011):6055-8.
364. Erdoes, T. and A. Tomcsanyi. 1958. The effect of a nonmetabolizable inductor on the benzoic acid-oxydase system of a mycobacterium. Acta Physiol. Acad. Sci. Hung. Suppl. 14:16-17.
365. Erkama, J., P. Saransaari, A. Sipila, and K. Tormala. 1969. Uptake of organic acids by the pea plant (*Pisum sativum*). Suom Kem. B. 42(4):244-246.
366. Eschena, T. 1957. The determination of benzoic acid and of pi-hydroxybenzoic acid in wine. Ann. Sper. Agrar. (Rome) 11:1301-10.
367. Esselen, Wm. B., Jr. 1962. Benzoate as a wartime food preservative. Glass Packer 21:56.
368. Estler, C. J. 1961. Glycogen content of brain and body temperature of white mice under the influence of some central inhibitory and stimulatory drugs. Med. Exptl. 4:209-213.
369. Evans, F. R., and H. R. Curran. 1948. Esters of vanillic acid as spore-controlling agents. Food Res. 13:66-69.
370. Evans, W.P. and Mrs. S.F. Dunbar. 1965. Effects of surfactants on germicides and preservatives. Soc. Chem. Ind. (London) Monograph No. 19:169-90.
371. Failey, R.B., Jr. and R.H. Childress. 1962. The influence of p-aminobenzoic-acid on the human serum cholesterin level. Am. J. Clin. Nutrit. 10:158-62.
372. Fairbairn, J. W., and S. J. Relph. 1968. Sources of error in quantitative paper and thin layer chromatography: I. Production of the initial spots. J. Chromatogr. 33(3/4):494-499.
373. Fajans, S.S., J.C. Floyd, Jr., R.F. Knopf, and J.W. Conn. 1967. Effect of amino acids and proteins on insulin secretion in man. Recent Progr. Hormone Res. 23:617-56.
- * 374. Fanelli, G. M., and S. L. Halliday. 1963. Relative toxicity of chlortetracycline and sodium benzoate after oral administration to rats. Archiv. Int. Pharmacodyn. 114(1/2):120-125.
375. Fang, V. 1968. Salicylate hypoglycemic action in alloxan-diabetic rats and structural relations. Arch. Int. Pharmacodyn. Ther. 176(1):193-208.

376. Fang, V., W.O. Foye, S.M. Robinson, and H.J. Jenkins. 1968. Hypoglycemic activity and chemical structure of the salicylates. *J. Pharm. Sci.* 57(12):2111-16.
377. Fara, G. 1961. Demonstration of preservatives in beverages by a microbiological method. I. Critical review of tests currently applied in practice. *Igiene Mod. (Parma)* 54:55-78.
378. Farber, L. 1954. Antibiotics as aids in fish preservation. I. Studies on fish fillets and shrimp. *Food Technol.* 8:503-505.
379. Farmer, V.C., M.E.K. Henderson, and J.D. Russell. 1959. Reduction of aromatic acids to aldehydes and alcohols by *polystictus versicolor*. *Biochim. Biophysica Acta (Amsterdam)* 35:202-11.
380. Fauchet, H.A. 1951. Studies on antiseptics in food. *Ing. Chimiste (Bruxelles)* 33 (March):18-54; (June):89-104.
381. Feldmann, R.J., and H.I. Maibach. 1968. Percutaneous penetration in man. *Proc. Joint Conf. Cosmet. Sci.* 189-203.
382. Fellegiova, M. 1961. Evaluation of benzoic acid as a preservative from the hygienic viewpoint and the method of its estimation. *Cesk. Hyg.* 6:613-7.
383. Fellers, C.R. 1929. Sodium benzoate and benzoic acid preservatives for cider and other fruit juices. *Fruit Products J. Am. Vinegar Ind.* 9:113-5.
384. Fellers, C.R., and E.W. Harvey. 1940. Effect of benzoated brine dips on keeping quality of fish fillets. *Food Res.* 5(1):1-12.
385. Fernandez, O., and M. de Mingo. 1934. Determination of pentosans in foods. *Anales Soc. Espan. Fis. Quim.* 32:382-90.
386. Ferrando, R. 1950. Influence of vitamin A on glycuronoconjugation in rats intoxicated with sodium benzoate. *Compt. Rend.* 231:1264-1266.
387. Ferriols, B. L., E. Hernandez, P. Cunat, and E. P. Yufero. 1961. Preservation of muscatel grape juice with sodium bisulfite, sodium benzoate, and potassium sorbate at limiting concentrations. *Rev. Agroquim. Technol. Alimentos* 1:22-30.
388. Ferriols, B. L., E. Hernandez, P. C. Broseta, and E. P. Yufera. 1961. Preservation of muscatel grape juice with sodium bisulfite, sodium benzoate, and potassium sorbate at their threshold concentrations. *Intern. Fruchtsaft-Union, Ber. Wiss.-Tech. Komm.* 3:151-166.
389. Ferriols, B.L., and E.H. Gimenez. 1963. Threshold values of organoleptic determination of preservatives in orange juice. *Rev. Agroquim. Technol. Alimentos* 3:129-35.
390. Fina, L.R., and A.M. Fiskin. 1960. The anerobic decomposition of benzoic acid during methane fermentation. II. Fate of carbons one and seven. *Arch. Biochem. and Biophys.* 91(2):163-165.

391. Finesinger, J., and T. J. Putnam. 1933. Induced variations in volume flow through the brain perfused at constant pressure. *J. Nerv. Ment. Dis.* 78(1):60-62.
392. Finkelman, I., J. Hora, I. C. Sherman, and M. K. Horwitt. 1940. Detoxication of sodium benzoate in neuropsychiatric disorders. The excretion of hippuric acid after the ingestion of sodium benzoate. *Am. J. Psychiat.* 96:951-960.
393. Fischer, A., L. Perenyi, and S. Rohny. 1958. Substrate specificity and origin of serum esterases. *Acta Med. Acad. Sci. Hung.* 12:229-237.
394. Fischer, E. 1958. Problems of medical mycology with special consideration of antimycotic pharmacotherapy. *Schweiz. Apotheker-Ztg.* 96:668-71.
395. Fischer, R. 1934. Identification of organic preservatives and commercial sweetening substances in foodstuffs. *Z. Untersuch. Lebensm.* 67:161-72.
396. Fischer, R., F. Georgi, R. Weber, and R.-M. Piaget. 1949. Psychophysical correlation. 7. Liver support therapy in schizophrenia. *Schweiz. Med. Wschr.* 80:129-135.
397. Fischer, R., and F. Stauder. 1930. Microchemical detection of benzoic acid, salicylic acid and para-oxybenzoic acid esters in food and medicinals. *Mikrochemie* 8:330-35.
398. Fischer, R., and F. Stauder. 1931. Detection of benzoic, salicylic and cinnamic acids, of saccharin and of the esters of p-hydroxybenzoic acid in wine. *Z. Untersuch. Lebensm.* 62:658-66.
399. Fishwick, B. 1957. Analysis of mixtures of benzene carboxylic acids by partition chromatography. *J. Chem. Soc.* 1196-9.
400. Fitch, C.D., C. Hsu, and J.S. Dirning. 1961. Partial reversal of creatine inhibition of transamidinase by dietary glycine. *Biochem. Biophys. Acta* 52:194-6.
401. Fitzgerald, R.J., and F. Bernheim. 1947. The effect of streptomycin on the metabolism of benzoic acid by certain mycobacteria. *J. Bact.* 54(6):671-679.
402. Fitzpatrick, F. K. 1954. Substances in plants acting on *Mycobacterium tuberculosis*. *Antibiotics and Chemotherapy* 4:528-536.
403. Florestano, H.J., and M.E. Bahler. 1952. Antifungal properties of the polymyxins. *Proc. Soc. Exptl. Biol. Med.* 79(1):141-143.
404. Florestano, H.J., M.E. Bahler and A.D. Chandler. 1957. Antimicrobial properties of beta-piperidinopropiophenons and related compounds. *J. Am. Pharmac. Assoc., Sci. Edit.* 46:539-42.

405. Fonda, M.L., and B.M. Anderson. 1968. D-Amino acid oxidase. II. Studie of substrate-competitive inhibitors. *J. Biol. Chem.* 243(8):1931-5.
406. Fonzes-Diacon. 1928. Antiseptics used for preserving samples of diseased wines: salicylic acid and sodium benzoate. *Ann. Fals.* 21:266-272.
- * 407. Ford, M. A. 1966. The quantitative determination of benzoic acid in soft drinks by ion-exchange chromatography. *Analyst* 91(1078)15-22.
408. Formijne, P. 1955. Influence of benzoic acid and oxybenzoic acids on the sedimentation degree of red blood cells. *Proc. Kon. Nederl. Akad. Wetensch. Ser. C.* 58:328-35.
409. Fournier, P. L., J. Gambier, and H. Fontaine. 1967. Effects of prolonged ingestion of sorbitol on calcium utilization and bone formation in the rat. *C. R. Hebd Seances Acad. Sci. Ser. D Sci. Natur. (Paris)* 264(10):1301-1304.
410. Frandsen, L. 1946. Antiseptic. *U. S. Pat.* 2,398,781, Apr. 23.
411. Frandsen, L. 1952. An antiseptic to retard bacterial decomposition of food. *U. S. Pat.* 2,622,030-1, Dec. 16.
412. Frandsen, L. 1952. Bacteriostatic and fungicidal solution for retarding food spoilage. *U. S. Pat.* 2,622,032, Dec. 16.
413. Frank, H. A., and C. O. Willits. 1961. Maple syrup. 17. Growth inhibition of mold mushrooms and yeast in maple syrup by chemical inhibitors. *Food Technol* 15:1-3.
414. Frenzel, G. 1961. Contribution to the discussion on the suggestions of the DAB 7 concerning the articles on benzoic acid. *Pharmazie* 16:34.
415. Friedler, L., and J.N. Smith. 1953. Formation of hippuric acid in locusts. *Biochem. J.* 55:VI.
416. Friedler, L., and J.N. Smith. 1954. Comparative detoxification. 3. Hippuric acid formation in mature locusts. *Biochem. J.* 57:396-400.
417. Frossard, P. 1968. Trials on the disinfection of pineapple stems against *Thielaviopsis paradoxa*. *Fruits (Paris)* 23(4):207-215.
418. Fruentov, N. K. 1953. Heightening of conditioned reflexes by codeine in nutritional leucocytosis. *Farmakol. i Toksikol.* 16(6):18-21.
419. Fuchs, W.H., and H. Metz. 1958. The influence of quinoximbenzoylhydraz on the growth of *Bacillus subtilis*. *Arch. Mikrobiol.* 31:60-67.
420. Fujii, S.J., and M. Harada. 1962. Food preservatives. I. Separation and analysis of mixed food preservatives by means of solvent extraction method. *Shokuhin Eiseigaku Zasshi* 3:172-8.
421. Fujiwara, M., and K. Fujiwara. 1968. Method for recovering preservatives in foods by steam distillation under reduced pressure. *Shokuhin Eiseigaku Zasshi* 9(2):147-54.

422. Fukuda, T., K. Miyakawa, and K. Ro. 1966. Effect of food additives on stability of ascorbic acid and sodium ascorbate solutions. III. Sodium alginate. *Shokuhin Eiseigaku Zasshi* 7(6):508-513.
423. Fukuda, T., K. Miyakawa, and T. Ueki. 1967. Effect of food additives on the stability of ascorbic acid and sodium ascorbate solutions. IV. A mixture of 32 mg.% sodium alginate and 0.05N citric acid. *Showa Yakka Daigaku Kiyo* 5:1-8.
424. Fukuda, T., T. Ueki, K. Miyakawa, K. Mimura. 1968. Effect of food additives on stability of ascorbic acid and Na ascorbate solutions. V. Sodium hexametaphosphate. *Shokuhin Eiseigaku Zasshi* 9(2):105-111.
425. Gaarder, R. H. J. 1932. Preservation of cheese. N. Pat. 50578.
426. Gachot, H. 1946. Sodium benzoate and fruit juices. *J. Vinicole* 5846:2.
427. Gaebler, O.H., W.T. Beher, and E.M. Crigger. 1951. Conjugation of benzoic acid and phenylacetic acids with glycine and glucuronic acid during induced growth (in dogs). *Fed. Proc.* 10(1):186.
428. Gaebler, O.H., W.T. Beher, and E.M. Crigger. 1953. Conjugation of benzoic and phenylacetic acids during nitrogen storage induced with growth hormone or testosterone propionate. *Am. J. Physiol.* 172(1):152-156.
429. Gaebler, O.H., H.C. Choitz and D. Kurrie. 1961. Effect of growth hormone on the conjugation of orally administered glycine with aromatic acids. *Am. J. Physiol.* 201:255-58.
430. Gakenheimer, H.E. 1954. Benzoates and hydroxybenzoates. *J. Assoc. Offic. Agr. Chemists* 37:382-3.
431. Gale, G. R. 1952. Oxidation of benzoic acid by *Mycobacteria*; metabolic pathways in *Mycobacterium tuberculosis*, *Mycobacterium butyricum* and *Mycobacterium phlei*. *J. Bact.* 63:273-278.
432. Gale, G.R. 1952. The oxidation of benzoic acid by mycobacteria. II. The metabolism of postulated intermediates in the benzoate oxidation chain by four avirulent and two virulent organisms. *J. Bact.* 64(1):131-135.
433. Gangl, J., and W. Lorenz. 1934. Determination of benzoic acid in foods. *Pharm. Monatsh.* 15:161-2.
434. Ganguly, U., and A. K. Mukherjee. 1962. Viewpoints of carbohydrate metabolism of the brain by experimental convulsive cramps. *J. Sci. Ind. Res. (New Delhi)* C 21:289-291.
- * 435. Gantenbein, W. M., and A. B. Karasz. 1969. Rapid screening procedure for determination of benzoic and sorbic acid in fruit beverages. *J. Assoc. Offic. Anal. Chem.* 52(4):738-741.

436. Garfinkel, D., and A. Lajtha. 1963. A metabolic inhomogeneity of glycine in vivo. I. Experimental determination. *J. Biol. Chem.* 238:2429-34.
437. Garrett, E.R., and O.R. Woods. 1953. Optimal application of acidic preservatives to oil-water systems: benzoic acid in the peanut oil-water system. *J. Am. Pharmac. Assoc., Sci. Edit.* 42:736-39.
438. Gavazzeni, M. 1935. The influence of sodium benzoate on gastric motility. *Arch. Ital. Mal. Appar. Diger.* 4:286-291.
439. Gaylor, J.L., R.W.F. Hardy, and C.A. Baumann. 1960. The effects of nicotine acid and related compounds on sterol metabolism in chickens and rats. *J. Nutrit.* 70:293-301.
440. Gehring & Neiweiser. 1953. Preservation of cucumbers and similar fruits with a large water content. *Ger. Pat.* 892,540 Kl. 53c., Oct. 8.
441. Genest, C., and D.G. Chapman. 1960. Qualitative extraction of certain antimicrobial preservatives from foods. *J. Assoc. Offic. Agr. Chemists* 43:438-9.
442. Gerber, G.B., and J. Remy-Defraigne. 1963. Detoxication by the perfused liver. I. Hippuric acid synthesis after irradiation. *Intern. J. Radiation. Biol.* 7(1):53-7.
- * 443. Gerlach, V. 1909. VII. Summary of the results. Pages 90-92 in V. Gerlach, *Physiological activity of benzoic acid and sodium benzoate*. Verlag von Heinrich Staadt, Wiesbaden.
444. Getmann, N. W. 1939. The treatment of lung abscesses and gangrene through intravenous injections of sodium benzoate. *Klin. Med.* 17(2)(2/3):95-98.
445. Georgi, F., C.G. Honegger, D. Jordan, H.P. Rieder, and M. Rottenberg. 1956. New findings with Quick hippuric acid test. *Nervenarzt* 27:421-3.
446. Gersdorff, W.A. 1943. Effect of introducing the carboxyl group into the phenol molecule on toxicity to goldfish. *Am. J. Pharm.* 115:159-67.
447. Gewuerz-Fabrik Karl Friedr. Baumann, Carla. 1954. Sausage skins. *Fr. Pat.* 1057,537.
448. Gibertini G. 1932. Detection of salicylic and benzoic acids present together in wines and foods in general. *Boll. Chim. Farm.* 71:397-8.
449. Gilberg, Y. 1953a. Tests on the keeping quality of light salted herring treated with acetic acid. *Fiskeridirektorat. Skrifter* 2(11):3-23.
450. Gilberg, Y. 1953b. The keeping quality of light salted herring cured without vinegar. *Fiskeridirektorat. Skrifter* 2(12):3-23.

451. Ginsburg, D.S. and T.S. Radsko. 1960. Influence of the structure of chemical compounds on their toxicity in contrast with the mold of *Synchytrium endobioticum* Perc. Izvest. Akad. Nauk. BSSR, Ser. Biol. Nauk. 3:31-38.
452. Goddijn, J.P. 1961. Quantitative determination of benzoic acid and sorbic acid. Z. Lebensmittel-Unters. Forsch. 115:534-38.
453. Goddijn, J.P., M. Van Praag, and H.J. Hardon. 1963. Quantitative gas chromatographic determination of benzoic acid, its derivatives and of sorbic acid. Z. Lebensmittel-Unters. Forsch. 123(4):300-305.
454. Golden, M.J., and K.A. Oster. 1947. Alcohol-soluble fungistatic and fungicidal compounds. II. Evaluation of a fungicidal laboratory test method. J. Am. Pharm. Assoc. Sci. Ed. 36:359-62.
455. Goldkorn, L. 1937. Treatment of gangrenous pulmonary suppuration with intravenous sodium benzoate. Presse Med. 45:131-134.
456. Gooding, C.M., D. Melnick, and H.W. Vahlteich. 1958. Packaging process. U.S. Pat. 2,858,225.
457. Goro, K., and T. Tomimura. 1954. Interrelation between the catalytic function of heme-proteins and the structural modifications of their protein parts. III. Effects of sodium salicylate and benzoate upon the reaction of choleglobin formation. J. Biochem. (Tokyo) 41(4):503-512.
458. Gortner, W.A., and R.W. Leeper. 1969. Studies on the relation of chemical structure to plant growth-regulator activity in the pineapple plant. V. Post-harvest delay of senescence of pineapple fruit. Bot. Gaz. 130(2):87-97.
459. Goshorn, R.H., E.F. Degering, and P.A. Tetrault. 1938. Antiseptic and bactericidal action of benzoic acid and inorganic salts, effect of pH. Indust. Engineer. Chem. 30(6):646-648.
460. Gottstein, U., W. Nierdermayer, and A. Bernsmeier. 1959. Cerebral circulation under the influence of vasoactive substances. Animal experiments with euphyllin, cordalin, caffeine, ronicol, papaverine and hydergin. Zeitschr. Ges. Exptl. Med. 131(5):430-439.
461. Gould, B.J., A.K. Huggins, and M.J.H. Smith. 1963. Inhibition of glutamic decarboxylase activity by salicylate. Biochem. J. 87:2P.
462. Gould, G. W. 1964. Effect of food preservatives on the growth of bacteria from spores. Intern. Symp. Food Microbiol. 4th Goteborg. Swed. 17-24.
463. Gounelle, H. 1963. On the use of benzoic acid for the preservation of flavoring materials. Bull. Acad. Nat. Med. (Paris) 147:121-2.
464. Graetz, B., M. Reiss, and G. Waldon. 1954. Benzoic acid detoxication in schizophrenic patients. J. Mental Sci. 100(418):145-148.

465. Grant, D. J. W. 1970. The oxidative degradation of benzoate and catechol by *Klebsiella aerogenes* (*Aerobacter aerogenes*).
Antonie Van Leeuwenhoek J. Microbiol. Serol. 36(1):161-177.
466. Grau, R., and K. Coretti. 1953. Studies with the preservative, hydrin.
Fleischwirtschaft 5:305-06.
467. Gray, C.H., and A. Neuberger. 1951. Studies of congenital porphyry. 1.
Incorporation of ¹⁴S in coproporphyrin, uroporphyrin, and hippuric acid. Biochemic. J. 47:81-87.
468. Green, M. W. 1948. Estimation of some official salts of weak organic acids by titration in a nonaqueous medium. J. Am. Pharm. Assoc., Sci. Ed. 37:240-242.
469. Gregson, R. A. 1969. Determination of a gustatory L70 point for sodium benzoate. Brit. J. Psychol. 60:187-197.
470. Grethe, T. 1925. Determination of benzoic acid in egg yolk. Z. Nahr. Genussm. 49:51-2.
471. Griebel, C. 1951. A new cinnamon adulterant. Z. Lebensm.-Untersuch. Forsch. 93:76-8.
472. Griffith, W. H. 1924. The absorption of sodium benzoate and of sodium hippurate from the small intestine of the rabbit. J. Biol. Chem. 59:li-iii.
473. Griffith, W.H. 1926. The conjugation of benzoic acid in rabbits. Proc. Soc. Exp. Biol. Med. 23(8):750-751.
474. Griffith, W. H. 1927. The effect of sodium benzoate on the growth of rats. J. Biol. Chem. 74(1):lxxv.
475. Griffith, W. H. 1928. Environmental and nutritional factors affecting the growth of rats on diets containing sodium benzoate. J. Biol. Chem. 78(1):xxiv.
476. Griffith, W.H. 1929a. Benzoylated amino acids in the animal organism. IV. A method for the investigation of the origin of glycine. J. Biol. Chem. 82:415-27.
- * 477. Griffith, W. H. 1929b. Growth of rats on diets containing sodium benzoate. Proc. Soc. Exptl. Biol. Med. 26(5):354-355.
478. Griffith, W. H. 1930. Effect of glucosamine and of glycollic acid on detoxication of sodium benzoate in rats. Proc. Soc. Exp. Biol. Med. 28(3):216-217.
479. Griffith, W. H. 1930. Benzoylated amino acids in the animal organism. V. The synthesis of glycine and of hippuric acid in rats. J. Biol. Chem. 85(3):751-758.
480. Griffith, W. H. 1937. Inhibition of tissue respiration by sodium benzoate and sodium hippurate. Proc. Soc. Exper. Biol. Med. 37:279-280.

481. Griffith, W. H., and H. B. Lewis. 1923. Synthesis of hippuric acid in the animal organism. VI. Influence of food protein on synthesis and excretion amount of hippuric acid after administration of benzoates. J. Biol. Chem. 57:697-707.
482. Grisebach, H. and K. Vollmer. 1964. On the biosynthesis of benzoic acid in *Gaultheria procumbens*. II. Zeitschr. Naturforsch. 19b(9):781-783.
483. Grimm, A. I. 1959. Use of antiseptics and antibiotics during storage of carrots. Sbornik Nauch. Rabot, Leningrad. Inst. Sovet. Torgovli im F. Engel'sa 15:17-27.
484. Groebel, W. 1965. Gas-chromatographic determination of sorbic acid, benzoic acid, and esters of p-hydroxybenzoic acid. Deut. Lebensm.-Rundschau 61(7):209-11.
485. Gross, G.C., E.F. Legering, and P.A. Tetrault. 1939. Correlation of the oil-water distribution ratios of some substituted acids with their bacteriostatic properties. Proc. Indiana Acad. Sci. 49:42-4.
486. Grossfeld, J. 1920. The detection and estimation of saccharin and benzoic acid in foods. Z. Ges. Kohlensaure Ind. 26:143-4, 159-60; Chimie and Industrie 5:579, 1921.
487. Grossfeld, J. 1927. The determination of small quantities of benzoic acid in milk, butter, margarine, meat and egg yolk. Z. Untersuch. Lebensm. 53:467-83.
488. Grove, J.F. 1953. Gladiol acid, a metabolism product of *Penicillium gladioli*. 2. Structure and fungistatic activity. Biochem. J. 54:664-673.
489. Grubb, H., and A. England. 1965. Methods for the determination of the content of preservatives in rennet and fruit preserves used in yoghurt. Arsberetn., Statens Forsoegsmejeri, Bil. No. 26:65-71.
490. Gruen, L., and H. Wirtz. 1964. Fish preserves with or without hexamethylentetramine. Dtsch. Lebensmittel-Rdsch. 60:14-18.
491. Gruszczynski, T., and E. Slominska-Czyzowa. 1956. Critical analysis of the La Wall and Bradshaw method in Dumbar's modification for the sodium benzoate determination in foods. Roczniki Panstwowego Zakladu Hig. 7:277-282.
492. Guerbet, M. 1920. A test for benzoic acid based on diazotization; applied to toxicological testing for atropine, cocaine and stovaine. J. Pharm. Chim. 22:321-3.
493. Guerin, M., et al. 1968. Metabolism of benzoic, phenylacetic and phenylbutyric acids by whole cells and cell-free extracts of *Mycobacterium phlei*. Bull. Soc. Chim. Biol. (Paris)50:187-93.
494. Guillot. 1963. A report on benzoic acid for the conservation of aromatic substances in the food industries. Presse Med. 71(9):470.

495. Guillot, M., and S. G. Ong. 1937. Inhibiting action of various substances which affect surface tension on the sensitivity of the isolated guinea pig intestine to acetylcholine and histamine. *Compt. Rend. Soc. Biol.* 126:318-320.
496. Guimberteau, G., and E. Portal. 1961. Benzoic acid and other phenolic acids in wines. *Ann. Fals. Expert Chim.* 54:330-7.
497. Gunsalus, I.C., C.F. Gunsalus, and R.Y. Stanier. 1953. The enzymatic conversion of mandelic acid to benzoic acid. I. Gross fractionation of the system into soluble and particulate components. *J. Bact.* 66(5):538-542.
498. Gunsalus, C.F., R.Y. Stanier, and I.C. Gunsalus. 1953b. The enzymatic conversion of mandelic acid to benzoic acid. III. Fractionation and properties of the soluble enzymes. *J. Bact.* 66(5):548-553.
499. Gunther, L., L. Strauss, H. H. Henstell, and H. Engelberg. 1942. Intramuscular pressure. III. Action of various drugs on patients with normal intramuscular and venous pressure. *Am. J. Med. Sci.* 204:387-394.
500. Guthenberg, H., and I. Beckman. 1963. Identification of preservatives by ultraviolet irradiation of paper chromatograms. *Z. Lebensm. Untersuch. Forsch.* 120(6):461-4.
501. Gutierrez-Noriega, C. 1946. The effect of coca and cocaine in thiamine deficiencies. *Rev. Med. Exptl. (Lima, Peru)* 5:1-12.
502. Guy, W.B. 1938. Cancer chemotherapy. *Med. World* 56:386-7.
503. Haberland, G.L., F. Bruns, and K.I. Altman. 1954. New metabolic pathway of phenylalanine and related substances in organism of rat; endogenous formation of benzoic acid. *Biochem. Ztschr.* 326:107-109.
504. Hadorn, H. 1951. A new determination method for benzoic acids in confections. *Mitt. Gebiete Lebensmittelunters. Hyg.* 42:226-32.
505. Hadorn, H., and F.H. Doevelaar. 1959. Assessment of a new colorimetric method for the determination of benzoic acid. *Mitt. Gebiete Lebensm. Hyg.* 50:435-45.
506. Haerdtl, H. 1963. Fungicidity of threshold values of chemical substances under various conditions. *Zbl. Bakteriол., Parasitenkunde, Infektionskrankh. Hyg., II. Abt.* 116:532-551.
507. Haeusler, H. F., and R. G. Filippi. 1954. Curved structure of arteries. III. Pharmacological structural analysis of coronary vessels. *Naunyn-Schmiedebergs Arch. Exptl. Pathol. Pharmacol.* 221:187-197.
- * 508. Hager, G. P., C. W. Chapman, and E. B. Starkey. 1942. The toxicity of benzoic acid for white rats. *J. Am. Pharm. Assoc.* 31:253-255.

- * 509. Hagiwara, B., T. Shibata, I. Sekuzu, F. Hattori, T. Nakayama, M. Nozaki, H. Matsubara, and K. Okunuki. 1956. Denaturation and inactivation of enzyme proteins. IV. Denaturation and inactivation of catalase. *J. Biochem. (Tokyo)* 43(4):495-508.
510. Haining, C. G. 1956. Inhibition of histamine release by sodium salicylate and other compounds. *Brit. J. Pharmacol.* 11:357-363.
511. Hainline, A., Jr. 1952. Some problems of biological conjugation of benzoic acid. Dissertation (Publ. 3756). Univ. of Michigan. 69 pp. University Microfilms, Ann Arbor, Mich. (Diss. Abstr.).
512. Hainline, A., Jr., and H. B. Lewis. 1953. The synthesis of hippuric acid and benzoylglucuronide in rabbits. *J. Biol. Chem.* 201:673-681.
513. Hall, L.A. 1950. Synergistic antioxidant. U.S. Pat. 2,511,802.
514. Hall, L.A. 1950. Antioxidant flakes. U.S. Pat. 2,511,803.
515. Hall, L.A. 1950. Antioxidant salt. U.S. Pat. 2,511,804.
516. Hall, L.A. 1950. Synergistic antioxidant containing amino acids. U.S. Pat. 2,518,233.
517. Hamaguchi, A., Y. Matsuki, and K. Tanaka. 1967. Analysis of preservatives in foods by ultraviolet spectrophotometry. *Shokuhin Eiseigaku Zasshi* 8(4):318-24.
518. Hamdy, A.M. 1966. Effect of some preservatives on the stability of rennet extract from sheep, and calves-vells. *Agr. Res. Rev. (Cairo)* 44(4):163-168.
519. Hanaoka, Y. 1965. Studies on preservation of soy sauce. III. Determination of benzoic acid in soy sauce. *Hakko-kogaku Zasshi* 43(4):249-254.
520. Hanaoka, Y. 1966. Studies on preservation of soy sauce. IV. On the lactic acid bacteria isolated from soy sauce pickles. *Hakko Kogaku Zasshi* 44(2):72-77.
521. Hanaoka, Y. 1967. Preservation of soy sauce. V. The effects of butyl p-hydroxybenzoate and benzoic acid in several soy sauces on yeast and lactic acid bacteria. *Hakko Kogaku Zasshi* 45(1):22-8.
522. Hanaoka, Y., and T. Yokotsuka. 1967. Preservation of soy sauce. VII. Benzoic acid in soy sauce and its mechanism of formation. *Hakko Kogaku Zasshi* 45(9):826-31.
523. Hansch, C., and T. Fujita. 1964. σ - π analysis. A method for the relation between biological activity and chemical structure. *J. Am. Chem. Soc.* 86:1616-26.
524. Hansen, O. R. 1962. Hammett series with biological activity. *Acta Chem. Scand.* 16:1593-1600.

525. Hardy, R.W.F., J.L. Gaylor, and C.A. Baumann. 1960. Biosynthesis of sterols and fatty acids as affected by nicotinic acid and related compounds. *J. Nutrition* 71:159-67.
526. Harral, J.C. 1930. Detection and determination of benzoic acid. *Analyst* 55:445.
- * 527. Harris, M. M., and R. S. Harris. 1949. Effect of administration of sodium benzoate on the level of glutamine in blood. *Proc. Soc. Exptl. Biol. Med.* 71:628-630.
528. Harris, P.N., M.E. Krah1, and G.H.A. Clowes. 1947. p-Dimethylaminoazobenzene carcinogenesis with purified diets varying in content of cysteine, cystine, liver extract, protein, riboflavin, and other factors. *Cancer Research* 7:162-75.
529. Harrow, B., I.M. Chamelin, and A. Mazur. 1937. Probable significance of glutathion as a detoxifying agent. *Proc. Soc. Exp. Biol. Med.* 37:271-73.
- * 530. Harshbarger, K. E. 1942. Report of a study on the toxicity of several food-preserving agents. *J. Dairy Sci.* 25:168-174.
531. Hartmann, F. 1961. The phenolic acid pattern in urine in patients with liver disease. *Klin. Wochschr.* 39:273-280.
532. Harvey, E.H. 1922. Effectiveness of common antiferments. *Am. J. Pharm.* 94:797-801.
533. Hasegawa, Y. 1958. Biosynthesis of vitamin C. 4. The influences of various glucuronic acid forming substances on vitamin C and glucuronic acid excretion in the urine of albino rats, guinea pigs and rabbits. *Seikagaku (Biochemistry)* 29:925-929.
534. Hazard, R., and G. Gouillet. 1962. Miotic action of procaine on enucleated frog eye. Synergistic action of sodium benzoate experiments with 933 F and Pilocarpine. *C. R. Seances Soc. Biol. Filiales* 156:245-248.
535. Heaton, E. K., T. S. Boggess, Jr., K. C. Ki. 1969. Processing refrigerated fresh peach slices. *Food Technol.* 23(7):956-960.
536. Hecht, G., and C. Gloxhuber. 1962. Effects of intraperitoneal injections of insoluble substances in rats. *Arch. Intern. Pharmacodyn.* 140:655-68.
537. Hegeman, G.D. 1966. Synthesis of the enzymes of the mandelate pathway by *Pseudomonas putida*. III. Isolation and properties of constitutive mutants. *J. Bacteriol.* 91(3):1161-7.
538. Heikal, H. A., M. H. El-Saidawy, H. M. Mansour, and F. A. El-Wakeil. 1967. Factors affecting preservation of orange juice in glass bottles. *Agr. Res. Rev. (Cairo)* 45(4):86-99.
539. Heikal, H. A., M. H. El-Saidawy, F. A. Ali, H. M. Mansour, and F. A. El-Wakeil. 1967. Processing of grapefruit juice. *Agr. Res. Rev. (Cairo)* 45(4):115-130.

540. Heller & Co., B., M. M. Voegeli, and H. J. Gorsica. 1964. Substance for treating fresh myoglobin-containing meat. U. S. Pat. 3,154,423.
541. Henderson, M.E.K. 1963. Mushroom metabolism of different aromatic compounds related to lignin. *Pure Appl. Chem.* 7:589-601.
542. Hendrickx, H. and A. de Vleeschauwer. 1951. Preventing molds on cheese. *Mededel. Landbouwhogeschool en Opzoekingsstas. Statt Gent.* 16:287-97.
543. Hernandez, H. R., and A. M. Mattocks. 1951. A spectrophotometric method for (the determination of) caffeine and sodium benzoate. *Bull. Natl. Formulary Comm.* 19:1-3.
544. Hernandez Gimenez, E., and B. Lafuente Ferriols. 1963. Orange juice preservatives. *Rev. Agroquim. Technol. Alimentos* 3(2):136-142.
545. Herner, B. 1944. Effect of benzoic acid and of related compounds on the ammonia formation in kidney and liver tissue of the rat. *Acta Physiol. Scand.* 8, Suppl. 23, 99 pp.
546. Hershman, J. M. 1963. Effect of various compounds on the binding of thyroxine to serum proteins in the rat. *Endocrinology* 72:799-803.
547. Hess, L. 1935. The influence of preservatives in fruit juices on flavor. *Obst- Gemuese-Verwertg.-Ind.* 22:383-385.
548. Hess, E., and N. E. Gibbons. 1942. Studies on salt fish. X. Effect of disinfectants and preservatives on red halophilic bacteria. *J. Fish. Res. Bd. Canada* 6(1):17-23.
- * 549. Hicks, J.M., I.D.P. Wooten, and D.S. Young. 1962. Effect of phenolic acids on cerebral enzymes. *Biochem. J.* 82:29P.
550. Hicks, J.M., D.S. Young, and I.D.P. Wootton. 1964. The effect of uremic blood constituents on certain cerebral enzymes. *Clin. Chim. Acta.* 9(3):228-35.
551. Higuchi, T., and D.A. Zuck. 1952. Solubilizing action of caffeiins on benzoic acid. *J. Am. Pharm. Assoc.* 41:10-13.
552. Higuchi, T., and D.A. Zuck. 1953. Investigation of some complexes formed in solution by caffeine. II. Benzoic acid and benzoate ion. *J. Am. Pharm. Assoc.* 42:132-8.
553. Hirashima, T. 1962. Pharmacological studies on the central nervous system by perfusion of the cerebral ventricles and subarachnoid space. I. Evaluation of the experimental method and the central effect of adrenaline and acetylcholine. *Nippon Yakurigaku Zasshi* 58:189-202.
554. Hirsch, P., and K. Richter. 1929. Use of indicators for the titration of the chief organic acids occurring in fruit and wine. *Z. Untersuch. Lebensm.* 58:433-48.

555. Hitchcock, M. and J.N. Smith. 1963. Detoxification mechanism in the tick, *Boophilus decoloratus*. *Biochem. J.* 87(3):34P-35P.
556. Hitchcock, M., and J.N. Smith. 1964. Comparative detoxification. 13. Detoxification of aromatic acids with arachnides; arginin - glutamin acid and glutamin conjugates. *Biochem. J.* 93:392-400.
557. Hitchcock, M. and J.N. Smith. 1966. Comparative detoxication. The detoxication of aromatic acids by invertebrates: detection of agmatine conjugates in scorpions. *Biochem. J.* 98:736-41.
558. Hitchens, R. M. 1935. Assay method for salts of organic acids. *J. Am. Pharm. Assoc.* 24:11-15.
559. Hoegl, O. 1953. Investigation and evaluation of dry coffee extracts. *Cardiologia (Basel)* 23:243-250.
560. Hoeller, H., and W. Schneider. 1954. Medicinal ulcer-therapy. *Subsidia Med. (Wien)* 6:87-94.
561. Hoeyem, T., and E. Nordboe. 1968. Preservatives in fresh meat products. *Medlemsbl. Nor. Veterinaerforen.* 20(3):114-17.
562. Hoffman, D.R., and D.H. Campbell. 1969. Model systems for the study of of drug hypersensitivity. I. Specificity of the rabbit anti-aspiryl system. *J. Immunol.* 103(4):655-61.
- * 563. Holden, H. F. 1947. The relation between some reversible reactions of haemoglobin and the formation of green derivatives. *Australian J. Exptl. Biol. Med. Sci.* 25(1):47-56.
564. Holdsworth, R.H. 1968. The presence of a crystalline matrix in pyrenoids of the diatom, *Achnanthes brevipes*. *J. Cell Biol.* 37(3):831-837.
565. Holtzapffel, D., and D.A.A. Mossell. 1968. The survival of pathogenic bacteria in, and the microbial spoilage of salads containing meat, fish and vegetables. *J. Food Technol.* 3(3):223-240.
- * 566. Honorato, R. 1949. Changes in the prothrombin time induced by methylxanthines. *Arch. Biochem.* 22:345-352.
567. Hope, G. W. 1965a. Temporary preservation of apple juice by preservatives and pH adjustment. *Food Technol.* 19(5):155-158.
568. Hope, G. W. 1965b. Temporary preservation of apple juice by preservatives and pH adjustment. *Food Technol.* 19(5):837-840.
569. Hopkins, H.S. 1922. Protoplasmic effects of papaverine, histamine and other drugs in relation to the theory of smooth muscle contraction. *Am. J. Physiol.* 61:551-61.
570. Hordh, U. 1930. Determination of benzoic acid in foods. *Anales Asocn. Quim. Argentina* 18:31-6.
571. Hordh, U. 1932. Determination of benzoic acid in foods. *Anales Asoc. Quim. Argentina* 20:176-80.

572. Hoshall, E.M. 1963. Report on preservatives and artificial sweeteners. J. Assoc. Off. Agr. Chemists 46:36-37.
573. Hosino, I. 1940. Behavior of liver in the long-continued administration of aromatic compounds. Zikken Syokakibyogaku (Exptl. Gastroenterol.) 15:5-49.
574. Hosokawa, Y., and K. Tsuji. 1953. Chemotherapeutic studies in tuberculosis. CII. The effect of various thiazole derivatives in combination with p-aminosalicylic acid or allied substances on the normal oxygen consumption of Mycobacterium tuberculosis var. hominis. Ann. Rept. Research Inst. Tuberc., Kanazawa Univ. 11:59-74.
575. Hostettler, H. 1932. The detection of salicylic acid, methyl, ethyl and propyl p-hydroxybenzoates, benzoic acid and p-chlorobenzoic acid in processed cheese. Mitt. Lebensm. Hyg. 23:65-70.
576. Hostettler, H. 1933. The detection of salicylic acid, p-hydroxybenzoic acid esters, benzoic acid and p-chlorobenzoic acid in processed cheese. Mitt. Lebensm. Hyg. 24:247-58.
577. Hottenroth, B. 1952. The effect of fruit product storage on the quality of jams. Z. Lebensmittel-Unters. Forsch. 94:11-22.
- * 578. Hoyem, T. 1962. Separation, identification, and estimation of aromatic food preservatives and sorbic acid by paper chromatography and ultraviolet spectrophotometry. J. Assoc. Offic. Agr. Chemists 45:902-905.
579. Hruban, Z., H. Swift, and A. Slesers. 1966. Ultrastructural alterations of hepatic microbodies. Lab. Invest. 15(12):1884-1901.
- * 580. Huang, H. T., and C. Niemann. 1952. The enzyme-inhibitor dissociation constants of alpha-chymotrypsin and several series of bifunctional competitive inhibitors. J. Am. Chem. 74:5963-67.
581. Hubbes, M. 1969. Benzoic and salicylic acids isolated from a glycoside of aspen bark and their effect on Hypoxylon pruinatum. Can. J. Bot. 47(8):1295-1301.
582. Huijsse, A.C. 1943. The Cu-pyridine reagent for the microchemical detection of organic acids. Tijdschr. Artsenijkunde 1:218-219.
583. Humphrey, G.F. 1948. Effect of narcotics on the endogenous respiration and succinate oxidation in oyster muscle. J. Marine Biol. Assoc. United Kingdom 27:504-12.
584. Humphreys, K.J., G. Richardson, and C.T. Rhodes. 1968. Effect of a nonionic surfactant on the antifungal activity of benzoic acid. J. Pharm. Pharmacol. 20 (Suppl):4-7.
585. Hurst, H. 1925. A contribution to the analysis of milk, condensed milk and dehydrated milk. Analyst 50:438-40.
586. Husa, W.J., and L.M. Husa. 1926. The effect of benzoic and cinnamic acids on the rate of development of rancidity in lard. J. Am. Pharm. Assoc. 15:1071-4.

587. Huston, M. J., and A. W. Martin. 1951. The effects of some analeptics on the somatic neuromuscular mechanism. *Arch. Intern. Pharmacodynamie* 87:493-501.
588. Hutschenreuter, R. 1956. Determination of preservatives in the fish-industry products. II. Determination, distribution, and residual of preservatives in fish-industry products. *Z. Lebensm.-Untersuch. Forsch.* 104:161-8.
- * 589. Ignat'ev, A. D. 1965. Experimental information contributing to a hygienic characterization of the combined effect produced by some chemical food preservatives. *Vop Pitan* 24(3):61-68.
- * 590. Iguchi, S., M. Yamamoto and T. Aoyama. 1963. Studies on medical preparations with gas chromatography. 1. Gas chromatography of preservatives. *J. Pharmac. Soc. Japan* 83:721-23.
591. Ikeda, T. 1962. On the influence of the administration of aromatic compounds upon the distribution of porphyrin bodies in tissues. I. The effect of phenylacetic acid, indoleacetic acid, and benzoic acid. *Mie. Med. J.* 12(2):111-118.
592. Ilievicky, J., D.L. Dinamarca, and M. Agosin. 1964. Activity of nicotinamidadenin-dinucleotid-kinase of *Triatoma infestans* nymphs after treatment with DDT and other compounds. *Comparat. Biochem. Physiol.* 11:291-301.
593. Illing, E.T. 1932. Mohler's test for benzoic acid. *Analyst* 57:224-32.
594. Illing, E.T. 1939. Mohler's test for benzoic acid. *Analyst* 64:586.
595. Inagaki, T. 1937. The influence of aromatic compounds upon the liver function. I. The influence upon the pigment-excreting function of the liver. *Japan. J. Gastroenterol.* 9:108-2.
596. Inamori, K., H. Nasu, Y. Sakamoto, and K. Ichihara. 1958. Enzymic hydroxylation of benzoic and phenylacetic acids. New pathway to homogentisic acid. *Proc. Japan Acad.* 34:645-8.
597. India, Standards Institution. 1969. Specification for sodium saccharin, food grade. *IS:5345 9PP.*
598. Infantellina, F. 1946. Vagus and sugar metabolism. II. Behavior of muscular, hepatic, and cardiac glycogen after administration of glucose and insulin into normal and vagotomized pigeons. *Boll. Soc. Ital. Biol. Sper.* 22:383-387.
599. Inglot, A.D., and E. Wolma. 1968. Reactions of nonsteroidal antiinflammatory drugs with the erythrocyte membrane. *Biochem. Pharmacol.* 17(2):269-79.
600. Ingram, M. 1960. Benzoate-resistant yeasts. *Acta Microbiol. Acad. Sci. Hung.* 7:95-105.
601. Ingram, M., and A.G. Kitchell. 1967. Salt as a preservative for foods. *J. Food Technol.* 2(1):1-15.

602. Inoue, T., T. Kawamura, M. Kamiyo, and M. Asakura. 1965. Preservatives in foods. IV. Detection and determination of benzoic acid by infrared absorption spectroscopy. *Shokuhin Eiseigaku Zasshi* 6(2):154-8.
603. Inoue, T., T. Kawamura, M. Kamiyo, Y. Sato, S. Kanno, S. Ochiai, and M. Nakaoka. 1966. Differential determination of several kinds of preservatives in foods by extraction and ion-exchange resin chromatography. *Shokuhin Eiseigaku Zasshi* 7(3):204-10.
604. Institut der Lebensmittelindustrie. 1933. Experimental materials on the preservation of fruit. *Lebensmittel- u. landwirtsch. Ind.* 3:3-24.
605. Intonti, R., F. C. Ramusino, and A. Stacchini. 1960. Spectrophotometric detection and determination of benzoic acid and methyl p-hydroxybenzoate in jams and nonalcoholic drinks. *Boll. Lab. Chim. Provinciali (Bologna)* 11(2):147-155.
606. Intoni, R., F.C. Rumusino, and A. Stacchini. 1961. Detection and quantitative spectrophotometric determination of benzoic acid and of methyl-p-oxybenzoate in beverages and marmalades. *Rend. Ist. Super. Sanita* 24(10):727-734.
607. Ioanid, N., and G. Bors. 1960. Poisonings by cyanogenic glucosides and their differentiation from those due to hydrocyanic acid or its salts. *Ann. Med. Legale et Criminol. Police Sci. et Toxicol.* 40(1):43-48.
608. Iranzo, J.R. 1966. Methods of analysis applicable to concentrated juices and other products from citrus fruits. *Conserve Deriv. Agrum. (Palermo)* 15(3):109-14.
- * 609. Irwin, M. H., J. Weber, and H. Steenbock. 1936. Influence of certain hydrotrophic and other substances on fat absorption. *J. Nutrition* 12:365-371.
610. Ishida, S. 1962. Organic acids and the fertilization membrane in *Anthocidaris crassipina* (A. agassiz). *J. College Arts Sci., Chiba Univ., Nat. Sci. Ser.* 3:495-502.
611. Ishii, Y. 1958. Chemotherapy of ascaris infection. *Yokohama Med. Bull.* 9:283-9.
612. Ishizeki, C., K. Aoyama, S. Hatta, Y. Fujita, Y. Oda, and M. Urabe. 1955. Food antiseptics. I. Comparison of antibacterial powers of benzyl p-hydroxybenzoate and various other food antiseptics. *Bull. Natl. Hyg. Lab., Tokyo No.* 73:237-43.
613. Isono, M. 1953. Oxidative phenyl acetic acid metabolism of *Penicillium chrysogenum* Q-176. 2. Disappearance of phenylacetic acid in penicillium culture mediums and manometric determination of phenyl acetic acid oxidation. *J. Agric. Chem. Soc. Japan (Nippon Nogeikagaku Kaishi)* 27:198-207.

614. Issoglio, G. 1926. Isolation and identification of benzoic acid in food products. Atti II Congresso Naz. Chim. Pura Applicata 1381-3.
615. Italy, Ministry of Health. 1968. Modification of regulation, 31st March 1965, concerning permitted chemical additives in the preparation and conservation of foods. Methods of analysis. Industria Conserve. 43(2):159-64.
616. Ito, N. 1937. The action of sodium caffeine benzoate on the lung blood vessels. Nagoya Igakkai Zasshi 45:1.
617. Ito, N., T. Sakakibara, and K. Fujita. 1956. Effects of histamine, caffeine-sodium benzoate, and phenobarbital on the relaxation and dehysteresis of glycerinated muscle fiber. Sapporo Igaku Zasshi 9:155-157.
618. Itoh, M., Y. Nakamura, and K. Shibata. 1962. Catalase inhibition by carboxylic acid following dissociation and association with apoprotein. Canad. J. Biochem. Physiol. 40:1327-34.
619. Iyer, V., and J. V. Bhat. 1952. Resistance of certain dominant bacilli to food preservatives. J. Sci. Ind. Res. (India) 11B:480-481.
620. Jacobsen, E. 1929. How does the preservative Albenal work in practice? Oesterreich. Spirituosen-Ztg. 28(28):3-4.
621. Jacobsen, E. 1929. How does the preservative Albenal work in practice? Braunschweig. Konserven-Ztg. 25:5-6.
622. Jacobsen, J.E., and G. Faulenborg. 1939. The influence of benzoic acid on the vitamin C value of preserved fruit. Zeitschr. Vitaminforsch. 9(1/2):48-61.
623. Jahnchen, E., J. Kriegelstein, and G. Kuschinsky. 1969. The significance of the benzene rings in protein binding of promazine and chlorpromazine. Naunyn-Schmiedebergs Arch. Pharmacol. Exp. Pathol. 263(2):376-386.
624. Jansen, F.C.M. 1936. Detection and determination of preservatives. Chem. Weekbl. 33:239-42.
625. Jansen, E. G. 1937. Pretreatment of potatoes. U. S. Pat. 2,069,884.
626. Jarczyński, R. and F. Kiermeier. 1954. The detection of preservatives in process cheese with the aid of paper chromatography. I. The detection of benzoic acid, p-chlorobenzoic acid, p-hydroxybenzoic acid, and their salts and esters. Z. Lebensm.-Untersuch. Forsch. 99:91-6.
627. Jaulmes, P. 1928. Studies on steam volatilization of acids important for wines. Ann. Falsifications 21:384-90.

628. Jaulmes, P., R. Mestres, and B. Mandrou. 1961. Spectrophotometric determination of benzoic acid in wines. *Ann. Fals. Expert. Chim.* 54:84-95.
629. Jefimotschkina, Je. F. 1959. The means of deaminations of natural amino acids in liver and kidney bird tissues. *Biokhimiya* 24:53-62.
630. Jeney, E., and T. Zsolnai. 1956. Tuberculostatic agents. *Zentr. Bakteriolog. Parasitenk. Abt. I. Orig.* 167:55-76, 254-264.
631. Jensen, V., and H. Orner. 1933. Use of different substances for preserving medicines. *Dansk. Tids. Farm.* 7:183-202, 205-221.
632. Joergensen, B. V., and H. A. Bak Henriksen. 1964. The microflora of semi-preserved fish products. *Intern. Symp. Food Microbiol.* 4th Goteborg, Swed. 231-243.
633. Johnson, E.B. 1936. Determination of small quantities of benzoic acid. *J. Soc. Chem. Ind.* 55:109-10T.
634. Jones, A. H., and G. S. Harper. 1952. A preliminary study of factors affecting the quality of pickles on the Canadian market. *Food Technol.* 6:304-308.
635. Jones, A.J. 1925. Colorimetric estimation of benzoic acid in cordials, etc. *Pharm. J.* 115:144-5; *Chemist & Druggist* 103:181.
636. Jones, O. 1925. Use of preservatives and artificial colors in food. *Ind. Chemist* 1:119-21.
637. Jorgensen, G. 1923. Determination of different acids in fruit juices and food. *Ann. Falsifications* 16:153-67.
638. Joseph, A. D., and R. B. Doctor. 1952. Extra-renal action of diuretics. *Antiseptic (Madras)* 49:379-381.
639. Joslyn, M.A. 1962. The chemistry of protopectin: a critical review of historical data and recent developments. *Advan. Food Res.* 11:1-107.
640. Joslyn, M. A., and W. V. Cruess. 1929. A comparative investigation of certain film-forming fungi. *Hilgardia* 4:201-240; *Expt. Sta. Record* 62:504.
641. Joslyn, M. A., and G. L. Marsh. 1934. Iodine-reducing value of orange juice. Effect of sodium benzoate and heat. *Ind. Eng. Chem.* 26:857-860.
642. Joubert, G. 1939. Study by ultraviolet spectrophotometry of the urinary elimination of salicylic and benzoic acids. *Compt. Rend. Soc. Biol.* 130:1412-16.

- * 643. Jowett, M., and J. H. Quastel. 1935a. CCV. Studies in fat metabolism. I. The oxidation of butyric, crotonic and beta-hydroxybutyric acids in the presence of guinea-pig liver slices. *Biochem. J.* 29:2143-58.
- * 644. Jowett, M., and J. H. Quastel. 1935b. CCLVI. Studies in fat metabolism. II. The oxidation of normal saturated fatty acids in the presence of liver slices. *Biochem. J.* 29:2159-2180.
- 645. Kajiro, K., G. Kikuchi, and M. Kawai. 1956. Reaction of verdohemoglobin formation in vitro, with special reference to its quantitative treatment. *J. Biochem.* 43:161-174.
- 646. Kamal'dinova, Z. M., T. A. Kochetkova, and Yu. P. Sanina. 1962. Toxicological characteristics of new chemical products from the synthesis of Terylene fiber. *Prom. Toksikol. i Klinika Prof. Zabolevanii Khim. Etiol.* (Moscow: Gos. Izd. Med. Lit.) Sb. 159-160.
- 647. Kameda, Y., E. Toyoura, and Y. Kimura. 1957. Metabolic activities of soil bacteria towards derivatives of benzoic acid, amino acids, and acylamino acids. *Kanazawa Daigaku Yakugakubu Kenkyu Nempo* 7:37-48.
- 648. Kamienski, B., Z. Bylo, and B. Waligora. 1952. Potentiometric chromatography VI. Properties of the adsorption electrode. *Bull. Inter. Acad. Polon. Sci., Classe Sci. Math. Nat. Ser. A.* No. 306A, 199-222.
- 649. Kanno, S. S. Ochiai, T. Nakaoka, T. Inoue, T. Kawamura, and M. Asakura. 1966. The differential determination of several kinds of preservatives in foods by a steam-distillation method. *Shokuhin Eiseigaku Zasshi* 7(2):134-9.
- 650. Kantor, H. I., D. A. Sutherland, J. T. Leonard, J. H. Kamholz, N. D. Fry, and W. L. White. 1961. Effect of bilirubin metabolism in the newborn of sulfisoxazole administered to the mother. *Obstet. Gynecol.* 17:494-500.
- * 651. Kaplan, E.H., J. Kennedy, and J. Davis. 1954. Effects of salicylate and other benzoates on oxidative enzymes of the tricarboxylic acid cycle in rat tissue homogenates. *Arch. Biochem. Biophys.* 51(1):47-61.
- 652. Kardashev, K.P. 1931. Standards for benzoic acid as a food preservative. *Izvestiya Tzentral. Nauch.-Issledovatel. Inst. Pishchevoi Vkusovoi Prom., Separate*, 32 pp.
- 653. Karrer, P. and E. Matter. 1948. Acid constituents of *Digitalis purpurea*. *Helv. Chim. Acta* 31:799-803.
- 654. Karsten, P., H. L. Kies, and P. de Hoog. 1960. Spectrophotometric acid-base titrations with the use of indicators. *Rec. Trav. Chim.* 79:610-616.

655. Kashima, T. 1954. Titration of nonaqueous solutions of drugs and chemicals. III. The determination of sodium salts of carboxylic acids in glacial acetic acid. Bull. Natl. Hyg. Lab. (Tokyo) 72:145-150.
656. Kaufmann, H.P. 1919a. The disinfective action of benzoic acid. I. Zentralblatt Bakter. Parasitenk. I. Abt. 83:581-90.
657. Kaufmann, H.P. 1919b. The disinfective action of benzoic acid. II. Zentralblatt Bakter. Parasitenk. I. Abt. 83:590-601.
658. Kaufman, H. P. 1919c. Benzoic acid as a disinfectant. Z. Angew. Chem. 32(1):199-200.
659. Kaulla, K.N.V. 1962. Chemical structure and induction of fibrinolysis. In vitro studies with 126 synthetic compounds. Thromb. Diath. Haemorrhag. 7:404-20.
660. Kawata, K. and Y. Isoda. 1955. The effect of sorbic acid as a preservative for sausage. Bull. Natl. Hyg. Lab., Tokyo 73:223-30.
661. Kawata, S. 1958. Nitrogen metabolism of the brain. V. Ammonia and glutamine contents of the brain of normal rats and mice. Okayama Igakkai Zasshi 70:1099-1102.
- * 662. Kaziro, K., G. Kikuchi, and M. Kawai. 1956. Biliverdin formation in vitro in view of its quantitative treatment. J. Biochem. (Tokyo) 43:161-174.
663. Keeser, E. 1950. The antagonism of thyroxine and benzoic acid. Klin. Wochschr. 28:494-5.
664. Kennedy, S.I.T. and C.A. Fewson. 1968. Metabolism of mandelate and related compounds by bacterium NCIB 8250. J. Gen. Microbiol. 53(2):259-273.
665. Kensaki, S. 1967. Clinical investigation of some liver diseases, cholecystopathia and diabetes mellitus upon the problem of blood sugar lowering effect by intravenous injection of sodium benzoate (human). World Congr. Gastroenterol. Proc. 3(3):144-148.
666. Kersten, D.K. 1964. Relation of hydrocarbon oxidating mycobacterias to different carbon sources. Mikrobiologiya (USSR) 33:31-37.
667. Khait, G. Ya. 1949. Titration of weak bases in nonaqueous solutions. Med. Prom. S.S.S.R. 4:35-38.
668. Khatina, A. I., A. N. Samsonova. 1969. Production of concentrated apple puree for the confectionery industry. Konservnaya i Ovoshchesushil'naya Promyshlennost' 7:16-17.
669. Khodasevich, A. P. 1956. Fatal caffeine poisoning (cases from practice). Farmakol. i Toksikol. 19:Suppl. 62.

- * 670. Kieckebusch, W., and K. Lang. 1960. Tolerance of benzoic acid in chronic feeding. *Arzneimittel-Forsch.* 10:1001-1003.
- * 671. Kikuchi, G., and T. Tomimura. 1954. Interrelation between the function of hem proteins and structural modifications of their protein parts. III. Effects of sodium salicylate and benzoate upon the reaction of choleglobin formation. *J. Biochem. (Japan)* 41(4):503-512.
- 672. Kilby, B.A. 1951. The formation of beta-ketoadipic acid by bacterial fission of aromatic rings. *Biochem. J.* 49(5):671-674.
- * 673. Kimmel, C. A., J. G. Wilson, and H. J. Schumacker. 1971. Studies on metabolism and identification of the causative agent in aspirin teratogenesis in rats. *Teratology* 4:15-24.
- 674. Kimura, K., K. Yamauchi, and S. Kuwano. 1959a. Studies on tannins, 8. Influence of tannins on the cystein-desulphydrase activity of *Escherichia coli*. *Chem. Pharmac. Bull. (Tokyo)* 7:426-34.
- 675. Kimura, K., K. Yamauchi, and S. Kuwano. 1959b. Studies on tannins, 9. Effect of tannins and related compounds on the tryptophanase activity of *Escherichia coli*. *Chem. Pharmac. Bull. (Tokyo)* 7:531-33.
- 676. Kimura, S., and K. Miyazaki. 1966. Dehydrated foods by freeze-drying. VIII. Selection of antioxidants by indirect addition of antioxidant. *Nippon Shokuhin Kogyo Gakkaishi* 13(3):100-103.
- 677. Kimura, S., and K. Shioda. 1966. Dehydrated foods by freeze-drying. VII. Selection of antioxidants by indirect addition of antioxidant. *Nippon Shokuhin Kogyo Gakkaishi* 13(3):95-100.
- 678. King, R.E., and J.S. Wragg. 1966. A rapid method for the estimation of impurities in saccharin and sodium saccharin. *J. Pharm. Pharmacol. Suppl.* 18:22-7.
- 679. Kingery, L.B., and A. Adkisson. 1928. Certain volatile oils and stearoptens as fungicides. *Arch. Dermatol. Syphilis* 17:499.
- * 680. Kingsbury, F. B. 1923. The synthesis and excretion of hippuric acid. *Proc. Soc. Exptl. Biol. Med.* 20:405-408.
- * 681. Kinsey, R. E., and D. O. Wright. 1944. Toxicity, reaction following ingestion of sodium benzoate in patient with severe liver damage; severe substernal pain, shock, increase in icterus, granulocytopenia and eosinophilia in colored male following hippuric acid excretion test. *J. Lab. Clin. Med.* 29:188-196.
- 682. Kinugasa, Y., M. Komori and M. Tanno. 1929. Determination of benzoic acid in fruit juices and sirups. *J. Pharm. Soc. Japan* 49:860-8.

683. Kirkland, J.J., and N.N. Durham. 1965. Synthesis of protocatechuatoxygenase by *Pseudomonas fluorescens* in the presence of exogenous carbon sources. *J. Bacteriol.* 90:15-22.
684. Kitagawa, M. 1956. Studies on the oxidation mechanism of methyl group. *J. Biochem. (Tokyo)* 43(4):553-563.
685. Klaembt, H.D. 1962. Conversion in plants of benzoic acid to salicylic acid and its betad-glucoside. *Nature* 196(4853):491.
686. Klein, J. R. 1957. Effect of competitive inhibitors on the inactivation of D-amino acid oxidase and its protein component by oxygen. *Arch. Biochem. Biophys.* 67:423-431.
- * 687. Klein, J.R., and H. Kamin. 1941. Inhibition of the d-amino acid oxidase by benzoic acid. *J. Biol. Chem.* 138(2):507-512.
- * 688. Klein, J. R. 1960. Competitive inhibition of D-amino-acid oxidase by benzoate as a function of substrate. *Biochim. et Biophys. Acta* 37:534-537.
689. Kliffmueller, R. 1956. Determination of sweetening agents and preservatives by paper chromatography. *Deut. Lebensm.-Rundschau* 52:182-4.
690. Klinke. 1929. Inhibition of blood coagulation with caffeine sodium benzoate. *Klin. Wochschr.* 8:1363.
691. Klodt, W., and B. Stieb. 1938. Studies on the influence of different chemical preservatives on the stability of natural and synthetic ascorbic acid. *Naunyn-Schmiedebergs Arch. Exp. Pathol. Pharmacol.* 189:509-13.
692. Kluge, H. 1933. Influence of preservatives on the action of enzymes. *Z. Untersuch. Lebensm.* 66:412-35.
693. Knoefel, P.K., K.C. Huang, and N.B. King. 1956. The biochemorphology of renal tubular transport: iodinated benzoic acids. *J. Pharmacol. Exptl. Therap.* 117:307-16.
694. Kobzarenko, V.S. 1939. Chemical preservatives and their determination in food products. *Akad. Nauk. U.S.S.R. Inst. Khem. Tekhnol. (Kiev):*113 pp.
695. Koch, R., and F. Staehler. 1963. Biological radiation protection. LI. The effect of chemical radiation protectants on in vitro irradiation of bovine serum albumin. *Strahlentherapie* 121(1):129-140.
696. Koczocik-Przedpelska, J. 1957. Effect of stimulation and sedation on the development of experimental neoplasma. *Acta Physiol. Polonica* 8:709-719.

697. Koechlin, B.A., M.A. Schwartz, and W.E. Oberhaensli. 1962. Metabolism of C14-iproniazid and C14-isocarboxazid in man. *J. Pharmacol. Exptl. Therap.* 138:11-20.
698. Koenig, W. 1931. Effect of preservatives on digestion in man. *Chem.-Ztg.* 55:934-935.
699. Koepke, O. and E. Bodlander. 1922. The determination of benzoic acid in margarine. *Z. Nahr. Genussm.* 43:345-50.
700. Koivusalo, M., and T. Luukkainen. 1959. Effect of benzoate and salicylate on the acetylation of p-aminobenzoic acid in ox kidney in vitro. *Acta Physiol. Scand.* 45:283-286.
701. Koivusalo, M., T. Luukkainen, T. Miettinen, and J. Pispa. 1958. Effect of benzoic acid on the metabolic conjugations of p-aminobenzoic acid in the rat. *Acta Chem. Scand.* 12:1919-1922.
702. Koivusalo, M, T. Luukkainen, T. Miettinen, and J. Pispa. 1959. Urinary metabolites of p-aminobenzoic acid in man. Effect of benzoate. *Ann. Med. Exptl. et Biol. Fenniae (Helsinki)* 37:93-99.
703. Kolmer, J.A., A. Bondi, Jr., H.F. Warner, and C. Dietz. 1946. Influence of sodium benzoate by ingestion upon urinary excretion of streptomycin. *Proc. Soc. Exper. Biol. Med.* 63:455-456.
704. Komendantova, M. V. 1958. Qualitative differences in the action of nerve stimulants (experimental study). *Farmakol. i Toksikol.* 21(1):3-9.
705. Komoda, T. and R. Takeshita. 1961. Paper chromatography and paper electrophoresis of food preservatives. *Shokuhin Eiseigaku Zasshi* 2:72-6.
706. Komoda, T. and R. Takeshita. 1962. Food additives. IV. A systematic analysis of preservatives in food. *Shokuhin Eiseigaku Zasshi* 3:374-81.
707. Komoda, T. and R. Takeshita. 1967. Studies on food additives (food preservatives, artificial sweeteners, etc.): VII. Detection of artificial sweeteners by thin-layer chromatography. *J. Hyg. Chem.* 13(4):204-206.
708. Komori, Y., Y. Sendju, J. Sagara, and M. Takamatsu. 1926. Studies in comparative biochemistry. II. Behavior of aromatic fatty acids and of pyridine in the organism of lower animals. *J. Biochem. (Tokyo)* 6:21-6.
709. Konek, F. and E. Wettstein. 1934. Determination of the organic acids of wine. *Math. Naturw. Anz. Ungar. Akad. Wiss.* 51:305-22.
710. Konishi, T. 1955. The effect of antituberculous drugs on the antigen-antibody reaction in vitro (precipitin reaction.) *Sogo Igaku* 12:149-153.

711. Kono, T. 1959. Absorption of calcium chloride and magnesium sulfate from rabbit intestine. *Nippon Yakurigaku Zasshi* 55:1089-1114.
712. Kooistra, J. A., J. A. Troller. 1965. Food preservative compositions and method for inhibiting microbial growth in food. U. S. Pat. 3,404,987. Oct. 8, 1968, Appl. 31 Mar. 1965.
713. Korshunov, I.A., Z.B. Kuznetsova, and M.K. Shchennikova. 1951. Polarographic determination of the concentration of weak acids. *Zhur. Anal. Khim.* 6:96-100.
- * 714. Koster, J. F., C. Veeger. 1968. The relation between temperature-inducible allosteric effects and the activation energies of amino-acid oxidases. *Biochim. Biophys. Acta* 167(1):48-63.
715. Kosuge, Y. 1934. Experimental study on the reaction of the blood vessels. I. Electric stimulation of the blood vessels. *Acta Schol. Med. Univ. Imp. Kyoto* 17:22-26.
716. Kotaki A., M. Naoi, and K. Yagi. 1966. A possible interpretation of the binding of d-amino acid oxidase with benzoate. *J. Biochem. (Tokyo)* 59(6):625-8.
717. Kotaki, A., M. Harada, and K. Yagi. 1966. Protective action of benzoate on the inactivation of D-amino acid oxidase by glyoxal. *J. Biochem. Tokyo* 60(5):592-594.
718. Kotakis, G.A. and E. Kokkoti-Kotakis. 1968. Detection of some preserving agents in foods and beverages. *Zesz. Probl. Postepow Nauk Roln.* 80:507-15.
719. Kotter, L., G. Terplan, and H. Schulz. 1959. Biological detection of preservatives in foods of animal origin. *Arch. Lebensmittelhyg.* 10:145-52.
720. Kovacs, A.S. and P. Denker. 1962. Identification and determination of food preservatives in foods. *Ind. Obst-Gemueserverwert* 47(1):1-3.
721. Kovacs, A.S., P. Denke, and H.O. Wolf. 1962. Detection and determination of preservatives in food. II. Determination of food preservatives. *Ind. Obst-Gemueseverwert* 47:547-59.
722. Koval'chuk, G. K. 1963. Action of proteolytic enzymes on fish protein during the presence of antiseptics. *Tr. Azovo-Chernomorsk. Nauchn.-Issled. Inst. Morsk. Rybn. Khoz. i Okeanogr.* 21:53-60.
- * 723. Kowalewski K. 1960. Abnormal pattern in tissue phospholipides and potassium produced in rats by dietary sodium benzoate. Protective action of glycine. *Arch. Intern. Pharmacodynamie* 124:275-280.
724. Kraft, H.-G., S. Sommer, and R. Hotovy. 1962. Analgetic action of 2-ethylamino-3-phenylnorcamphan and other central stimulants. *Arzneimittel-Forsch.* 12:469-472.

- * 725. Kramer, M., and R. Tarjan. 1962. Effects of preservatives on the utilization of carotene. Intern. Z. Vitaminforsch. 32:149-157.
- 726. Kramer, P.E., M.L. Robbins, and P.K. Smith. 1955. Phenolic compounds as chemotherapeutic agents against poliomyelitis virus in tissue culture. J. Pharmacol. Exptl. Therap. 113:262-71.
- 727. Krausz, I., and A. Endroi-Havas. 1960. Displacement titrations utilizing high-frequency end-point indication. Ann. Univ. Sci. Budapest R. Eoetvoes nominatae. Sect. Chim. 2:325-327.
- 728. Krebs, H.A. and P. de Gasquet. 1964. Inhibition of gluconeogenesis by alpha-oxo acids. Biochem. J. 90(1):149-54.
- * 729. Kreis, H., K. Frese, and G. Wilmes. 1967. Physiological and histological changes in rats fed benzoic acid (preservative). Food Cosmet. Toxicol. 5(4):505-511.
- 730. Krishnaswamy, M.A., T.M. Rudrasetty, and G.D. Revankar. 1964. Some species of fish and preservatives in the manufacture of fish sausage. J. Food Sci. Technol. 1(4):64-7.
- 731. Krushinskii, L. V., L. P. Dobrokhotova, and N. I. Mashkova. 1969. Experimental study of the effect of an anti-convulsive mixture in combination with different doses of chlorpromazine. Biol. Nauk. 12(5):43-45.
- 732. Krylov, A. A. 1960. Effect of doses of sodium benzoate on the bilirubin excretory function of the liver in acute and chronic hepatitis. Terap. Arkh. 32(6):54-58.
- 733. Kubo, H. 1954. On change of alkaline phosphatase in blood cells and sugar in blood of rabbit by some drugs. (Report 1). Kumamoto Med. J. 7(1):15-28.
- 734. Kuhn, R. and K. Schwarz. 1941. Isolation of the growth-promoting substance H⁺ from yeast. Ber. 74B:1617-24.
- 735. Kumon, T. 1935. Detoxication processes in the rabbit during B-avitaminosis. J. Biochem. 22:213-24.
- 736. Kunze, A. 1935. Sweet must and chemical preservatives. Obst-Gemuse-Verwertg.-Ind. 22:213-15.
- 737. Kuprianoff, J. 1957. On the question of pasteurization of eggs and egg products. Dtsch. Lebensmittel-Rdsch. 53:221-227.
- 738. Kuroda, T. 1926. Influence of hydrogen-ion concentration upon the antiseptic action of some phenols and aromatic compounds. Biochem. Z. 169:281-91.

739. Kuroda, T. 1955. The influence of various substances on the absorption of iron in the large intestine. *Folia Pharmacol. Japon* 51:443-475.
740. Kúrtz, A. 1942. Determination of salicyclic and benzoic acids in the presence of each other in preserved food. *Mezogazdasagi Kutatasok* 15:10-16.
741. Kushida, T. and C. Taki. 1955. Wine preservatives. *J. Soc. Brewing, Japan* 50:526-30.
742. Kuttner, R. and H. Wagreich. 1953. Some inhibitors of mushroom catecholase. *Arch. Biochem. Biophys.* 43(1):80-87.
743. Kyzlink, B. and M. Curdova. 1969. Chemical and physico-chemical evaluation of ketchups. *Prumysl Potravin* 20(12):356-58.
744. Labes, R. 1921. Speed increases and intensity of toxicity effect of groups of toxic or pharmacologically effective substances on bacteria and tadpoles by variation of acidity/alkalinity degree. A contribution to the question of permeability. *Biochem. Z.* 130:14-24.
745. Lagoni, H. 1941. Comparative studies on the microbicidic effect of different preservatives. *Zentralbl. Bakt. II. Abt.* 103(12/14):225-231.
746. La Manua, A., G. Pagani, P. Pratesi, and M.L. Ricciardi. 1964. Antiamebic activity of simple arylaliphatic acids. *Farmaco (Pavia), Ed. Sci.* 19(6):506-14.
747. Lambin, S., A. German, and J. Bernard. 1961. Mechanism of action of certain bacteriostatic substances on *Staphylococcus aureus* determined by means of a study of growth curves. *Ann. Inst. Pasteur* 100:427-444.
748. Lambion, R., E. Jacqmain, and J. Bessemans. 1968. Detection of antiseptics in foods by thin-layer chromatography. *Qual. Plant. Mater, Veg.* 16(1-4):270-91.
749. Lamprecht, F. 1955. Combating bread mold, especially *Trichosporon variabile*. *Brot Gebaeck* 9:26-30.
- * 750. Lang, H., and K. Lang. 1956. Fate of benzoic acid-C¹⁴ and p-chlorobenzoic acid-C¹⁴ in the organism. *Naunyn-Schmiedeberg's Arch. Exptl. Pathol. Pharmacol.* 229:505-12.
751. Lapiere, C. 1948. Photometric determination of benzoic, salicyclic, and acetylsalicyclic acids. *J. Pharm. Belg.* 3:123-8.
752. Larson, E., J. P. Adams, Jr., and M. F. Wynn. 1953. Effect of certain compounds on the biological inactivation of epinephrin. *Arch. Int. Pharmacodynam. Therap.* 94:367-382.
753. Launer, H.F. and Y. Tomimatsu. 1953. Rapid accurate determination of carbohydrates and other substances with the dichromate heat-of-dilution method. *Anal. Chem.* 25:1767-9.

754. Leather, A.N. 1931. Detection of benzoic acid. *Analyst* 56:299-304.
755. Lee, F. A., W. B. Robinson, J. C. Hening, and C. S. Pederson. 1950. Low-temperature preservation of fruit juices and fruit juice concentrates. *Agr. Expt. Sta., Bull.* 743:3-18.
756. Lee, J. S., et al. 1965. Radiation pasteurization of seafood. I. The combined effect of sodium benzoate and irradiation for retarding microbial growth in Dover sole (*Microstomus pacificus*). *Int. J. Appl. Radiat.* 16:221-226.
757. Le Heux, J.W. 1921. Cholin as an hormone of intestine movement. III. The contribution of cholin to the action of different organic acids on the intestine. *Arch. Physiol.* 190:280-300.
758. Lehner, E., and F. Urban. 1927. Changes in the sensitiveness of the skin after intravenous injection of definite chemical irritants, and after intravenous blood injection. *Krankheitsforsch.* 4:375-380.
759. Lehmann, K.B., and L. Schmidt-Kehl. 1933. The usefulness of benzoic acid in the prolongation of sausage preservation. *Dtsch. Nahrungsmittel-Rdsch.* 137-41, 145-49.
760. Lemeshek, K. 1969. Chemical substances for foodstuffs conservation. *Pishchevaya Promyshlennost*, Moscow, 103 pp.
761. Lemon, H. M., W. H. Chasen, and J. M. Looney. 1952. Abnormal glycine metabolism in rheumatoid arthritis. *J. Clin. Invest.* 31:993-999.
762. Lenhart, J. and K.W. Cosens. 1949. Molds and bacteria curbed in immersion-freezing. *Food Indust.* 21(4):442-444.
763. Leonardi, G., and F. Campus. 1948. Mechanism of the synergetic action of antibiotic and chemotherapeutic agents. IV. Inhibition of the inactivating power of serum on streptomycin by sulfamides in vitro. *Boll. Soc. Ital. Biol. Sper.* 24:632-633.
764. LeRosen, A.L., P.H. Monaghan, C.A. Rivet, E.D. Smith, and H.A. Suter. 1950. Streak reagents for chromatography. *Anal. Chem.* 22:809-11.
765. Leuschner, F., R. Poche, C. Gloxhuber. 1969. Toxicological examination of a dish-washing agent. *Fette, Seifen, Anstrichm.* 71(7):570-580.
766. Leuthardt, F. 1941. Glutamine metabolism. *Schweiz. Med. Wochschr.* 71:322-3.
767. Leuthardt, F. and H. Nielsen. 1951. Studies on the biological synthesis of hippuric acid. *Helv. Chim. Acta* 34:1618-31.
768. Levi'eva, L. S., S. I. Ivanova. 1961. Effect of a preservative on aging and stability of canned goods. *Nauchn.-Tekhn. Byul. Nauchn.-Issled. Inst. Mekhan. Rybn. Prom.* 9-10:61-69.

769. Levieva, L. S., and S. I. Ivanova. 1962. Effect of preservatives on ripening and keeping quality of canned fish products. *Fischereiforschung* 5(2):26-30.
770. Levin, N. and R. Steenhoff. 1936. Fruit juices and preservatives in the Lemonade Industry. *Svenska Bryggareforen Manadsbl.* 51:185-95.
- * 771. Levy, G. 1965. Pharmacokinetics of salicylate elimination in man. *J. Pharm. Sci.* 54(7):959-967.
- * 772. Levy, G., L. P. Amsel, and H. C. Elliott. 1969. Kinetics of salicyluric acid elimination in man. *J. Pharm. Sci.* 58(7):827-829.
773. Lewis, D.R., and J. Payne. 1958. Benzoic acid as a fungicide, particularly for citrus fruits. *Brit. Pat.* 794,769.
774. Lewis, H. B., and W. H. Griffith. 1923. The synthesis and rate of elimination of hippuric acid in the organism of the rabbit. *Proc. Am. Soc. Biol. Chem., J. Biol. Chem.* 55:xxii-xxiii.
775. Lewis, M. H. 1968. Determination of hydroxybenzoates and benzoates (preservatives) in foods. *J. Ass. Offic. Anal. Chem.* 51(4):876-877.
776. Lewis, M. H. 1967. Benzoates in foods. *J. Ass. Offic. Anal. Chem.* 50(4):985-988.
777. Lewis, S.J. 1933. Testing jams with the spectroscope. *Food Manuf.* 8:421-24.
778. Lewis, Y. S., and D. S. Johar. 1958. Control of fermentation in settling tanks of sago factories. *Food Sci. (Mysore)* 7:285.
779. Lidner, K., and E. Sandell. 1946. Sebum and sebum salicylatum as regards rancidity. *Svensk Farm. Tid.* 48:317-22.
780. Lieberman, T. Yu. 1963. Effects on cerebrovascular tonus caused by some headache remedies in hypertensive patients. *Farmakol. i Toksikol.* 26(5):573-578.
781. Liese, W. 1933. Bacteriologic and biologic tests with benzoic acid and benzoic acid derivatives. *Arch. Hyg. Bakteriol.* 110:355-64.
782. Liese, W. 1933. Benzoic acid and the conservation of foods. *Chem.-Ztg.* 57:315.
783. Lillie, R.S. 1927. The activation of starfish eggs by acids. II. The action of substituted benzoic acids and of benzoic and salicylic acids as influenced by their salts. *J. Gen. Physiol.* 10(5):703-723.

784. Lindeboom, G.A. 1947. The influence of benzoic acid on the excretion of uric acid. *Acta Brevia Neerland* 15(2/4):27-31.
785. Lindenbaum, A. and J. Schubert. 1956. Binding of organic anions by serum albumin. *J. Phys. Chem.* 60:1663-5.
786. Lindsey, M. 1951. Tea sirup. U. S. Pat. 2,559,194, July 3.
787. Lipmann, F., and L. C. Tuttle. 1950. Lipase-catalyzed condensation of fatty acids with hydroxylamine. *Biochim. Biophysica Acta* (Amsterdam) 4:301-309.
788. Littlejohn, O.M. and W.J. Husa. 1955. The increasing effect of mushroom growth inhibiting substances in syrups. *J. Am. Pharmac. Assoc. Sci. Edit.* 44:305-08.
789. Lochhead, A. G., and L. Farrell. 1930. The effect of preservatives on fermentation by sugar-tolerant yeasts from honey. *Canadian J. Res.* 3(2):95-103.
790. Lochner, W., H. Mercker, and E. Schuermeyer. 1956. Effect of vasoactive pharmaca on oxygen saturation of coronary sinus blood. *Naunyn-Schmiedebergs Arch. Exp. Pathol. Pharmacol.* 227:373-382.
791. Locker, A., and K. H. Spitzzy. 1956. Influencing of penicillin activation through respiring liver tissue. *Z. Ges. Exp. Med.* 125:225-228.
792. Loman, J., and A. Myerson. 1932. The action of certain drugs on the cerebrospinal fluid and on the internal jugular venous and systemic arterial pressures of man. *Arch. Neurol. Psychiatr.* 27(5):1226-1244.
793. Lombroso, U., C. Zummo, and M. Stassi. 1934. Nitrogen metabolism. II. Production of glycine during benzoic acid poisoning. *Arch. Intern. Physiol.* 39:1-23.
794. Lorenzen, W., and R. Sieh. 1962. Rapid spectrophotometric determination of preservatives in food. *Z. Lebensm.-Untersuch. Forsch.* 118:223-33.
795. Loughlin, J.E. 1961. Acids in foods. *Dyestuffs* 44:31-39.
796. Lowenthal, J., and L.B. Jaques. 1953. A comparative study of the action of aromatic acids on the ascorbic acid content of the adrenal gland. *J. Pharmacol. Exp. Therapeut.* 107:172-77.
797. Lubieniecki von Schelhorn, M. 1964. Hypothesis for the spoilage of fat-containing waffle fillings and possibilities for inhibiting this spoilage. *Suesswaren* 8:1146, 1148, 1150, 1152-3.
798. Lubieniecki von Schelhorn, M. 1964. Distribution of preservatives between fat and water in foods. *Intern. Symp. Food Microbiol.* 4th, Goteborg, Swed. 139-44.

799. Lubieniecki-von Schelhorn, M. 1964. Distribution of preservatives between fat and water in food. Food Microbiol., Goteborg 139-44.
800. Lubieniecki-von Schelhorn, M. 1967. Distribution of preservatives between fat and water. II. Relation between physical-chemical distribution and antimicrobial effectiveness of preservatives in fat-containing foods. Z. Lebensm.-Unters. Forsch. 133(4):227-41.
- * 801. Lucas, D. R. 1909. Some effects of sodium benzoate. Proc. Soc. Exptl. Biol. Med. 6:122-126.
802. Luck, J.M., and A.S. Schmit. 1948. Combination of serum albumin with organic compounds. V. Experiments with hydroxy-substituted aromatic acids. Stanford Med. Bull. 6:133-41.
803. Ludwig, E., and U. Freimuth. 1965. Thin-layer chromatography in food chemistry. V. Identification of some organic preservatives by means of polyamide layers. Nahrung 9(7):751-754.
804. Lueck, E., and W. Courtial. 1965. Thin-layer chromatographic separation of the preservatives benzoic acid and sorbic acid. Deut. Lebensm.-Rundschau 61(3):78-79.
805. Lueck, H. 1957. Catalase inhibition by organic acids. Biochem. Z. 328:411-19.
806. Lueck, H. 1958. Peroxydase inhibition by organic acids. Enzymologia 19:227-36.
807. Lueck, H. 1958. Influence of preservatives on hemin enzymes. 1. General effect. Z. Lebensmittel-Unters. u. Forsch. 108:1-9.
808. Lueck, H. 1959. Food additives and mutagenic effect. 5. Studies on the production of a streptomycin resistance in Escherichia coli with benzoic acid and ethyl paraben. Zbl. Bakteriол., Parasitenkunde, Infektionskrankh. Hyg. II. Abt. 112:226-34.
809. Lueck, H. 1960. Influence of preservatives on hemin enzymes. II. A correlation between the preservative effect of organic acids and their catalase inhibition. Z. Lebensm.-Untersuch. u. Forsch. 111:190-198.
810. Lueck, H., and E. Rickerl. 1959. Studies with Escherichia coli on increasing resistance to preservatives and antibiotics. Z. Lebensmittel-Unters. u. Forsch. 109:322-29.
811. Luers, H. and F. Weinfurtner. 1926. Determining the effectiveness of trade disinfectants. Wochschr. Brau. 43:25-9, 35-9, 45-9.
812. Lustig, B. and H. Wachtel. 1936. The relation between the steric grouping of atoms and malignant tumors in the cytolytic reaction of Freund and Kaminer under different conditions. Z. Krebsforsch. 43:343-58.

813. Lutwak-Mann, C. 1942. The effect of salicylate and cinchophen on enzymes and metabolic processes. *Biochem. J.* 36:706-728.
814. Lyczewska, J., and A. Rafalowicz. 1963. Hippuric and benzoylglucuronic acid excretion after sodium benzoate loading in healthy persons and in liver damage. *Med. Doswiadczalna Mikrobiol.* 15(4):349-358.
815. Lyczewska, J., et al. 1964. Excretion of hippuric acid and benzoylglucuronic acid following sodium benzoate load in normal subjects and in liver diseases. *J. Pharm. Soc. Jap.* 84:52-56.
816. Machado, A. 1933. Effect of chemical substances administered in vitro on the development of coli bacteria. *Bol. Ass. Brasil. Pharmaceut.* 14:343-345.
817. Machek, G., and F. Lorenz. 1966. Indirect spectrophotometric analysis of mixtures of two and more substances. IV. Analysis of quaternary mixtures. *Sci. Pharm.* 34(3):213-231.
818. Macht, D. I. 1926. Photopharmacology. V. Influence of sun's rays on growth of yeast in sodium benzoate. *Proc. Soc. Exptl. Biol. Med.* 23:638-639.
819. Madhyastha, K.M., and P.K. Bhattacharyya. 1968. Microbiological transformations of terpenes. XIII. Pathways for degradation of p-cymene in a soil pseudomonad (PL-strain). *Indian J. Biochem.* 5(4):161-7.
820. Maeda, M. 1935. The influence of various purine derivatives on the growth, as well as the morphological picture of cultures of fibroblast in vitro. *Folia Pharmacol. Japon.* 20:293-310.
821. Mahlen, S. 1928. Studies on the influence of benzoic acid and of the three isomeric hydroxybenzoic acids on succinodehydrogenase. *Skand. Arch. Physiol.* 53:152-75.
822. Mainx, F. 1924. Studies on the effect of poisons on mitosis. *Zool. Jahrb. Abt. Allg. Zool. Phys. Tiere* 41:553-80.
823. Mair-Waldburg, H., and W. Sturm. 1955. Detection of preservative in processed cheese. *Z. Lebensm.-Untersuch. Forsch.* 100:51-4.
824. Malesett-Bras, M., and E. Azoulay. 1965. Bacterial degradation of naphthalines. *Ann. Inst. Pasteur* 109:894-906.
825. Mameesh, M. S. 1965. Glucuronide detoxication mechanisms in vitamin A-deficient rats. *Acta Pharmacol. Toxicol.* 22(3):235-240.
826. Mameli, E. and E. Filippi. 1926. Biothermic action of organic substances. *Ann. Chim. Applicata* 16:556-602.

827. Mangat, S. S. 1944. Determination of sodium benzoate in preserved citrus juices and squashes. *Indian J. Agr. Sci.* 14:319-321.
828. Mannheim, H. C., A. I. Nelson, and M. P. Steinberg. 1957. Film packaging of heat-processed orange-juice products. I. Some factors affecting stability of the product. *Food Technol.* 11:417-420.
829. Margheri, G., and P. Michelotti. 1966. Presence and determination of benzoic acid in red whortleberries. *Boll. Lab. Chim. Prov. (Bologna)* 17(1):85-91.
830. Marinelli, L., M.F. Feil, and A. Schait. 1968. The isolation and identification of organic acids in beer. *Proceedings, Am. Soc. of Brewing Chemists* 113-19.
831. Marples, E., and S. Z. Levine. 1936. Creatinuria of infancy and childhood. I. Normal variations: creatine-tolerance tests and the effect of aminoacetic acid in normal infants. *Am. J. Diseases Children* 51:30-57.
- * 832. Marquardt, P. 1960. Tolerance of benzoic acid. *Arzneimittel-Forsch.* 10:1033.
833. Marshall, F. D., Jr. 1966. Effects of feeding benzoate on enzymic benzoylation of ornithine. *Life Sci.* 5(12):1077-1081.
- * 834. Martin, A. K. 1966. Metabolism of benzoic acid by sheep. *J. Sci. Food Agr.* 17(11):496-500.
835. Martin, A.K. 1969. Urinary excretion of aromatic acids by starved sheep. *Brit. J. Nutr.* 23(3):715-25.
836. Martin, F.M., and M. del Carmen de la Torre. 1957. Determination of benzoic acid and salicylic acid in food. *Medicamenta (Madrid)* 18(9), 158:287-291.
837. Martin, G.J. 1948. The effect of various agents on the excretion of uric acid and allantoin. *Exptl. Med. and Surg.* 6:24-7.
838. Martinetti, B. 1938. Pressure changes after intravenous caffeine injection in man. *Arch. Farmacol. Sperim. Sci. Affini* 66(37):59-68.
839. Maruyama, Y. 1958. Influence of growth phase on enzymic adaptation of bacteria. *J. Biochem. (Tokyo)* 45:169-75.
840. Marzat, J., P. Romain, and P. Mesnard. 1955. Application of Elbs' reaction to the identification of benzoic acid. *Bull. Soc. Pharm. Bordeaux* 93:81-3.
841. Mascotti, N. and E. Emiliani. 1960. Effect of several substances on *Aspergillus niger* in a strongly acidic medium. *Rev. Fac. Ing. Quim.* 29:133-43.

842. Mason, H.S., I. Onopryenko, and D. Buhler. 1957. Hydroxylisation: the activation of oxygen by peroxidase. *Biochim. Biophysica Acta* (Amsterdam) 24:225-26.
843. Mason, M. 1959. Kynurenintransaminase: study of the inhibitors and their relation to the active region. *J. Biol. Chemistry* 234:2770-73.
844. Massey, V., and H. Ganther. 1965. Interpretation of the absorption spectra of flavoproteins with special reference to D-amino acid oxidase. *Biochemistry* 4(6):1161-1173.
845. Massey, V., H. Ganther, P.E. Brumby, and B. Curti. 1965. D-Amino acid oxidase. *Oxidases Related Redox Systems, Proc. Symp. Amherst, Mass.*, 1:335-52.
846. Mathews, D.H., and T.R. Welch. 1958. Potentiometric titrations of weak acids in nonaqueous solvents. I. Benzoic acid, epsilon-cyclohexylcaproic acid, p-cresol, and 1-naphthol. *J. Appl. Chem.* 8:701-10.
847. Matsuda, G., Y. Nishioka, Y. Okamura, I. Kiya, and A. Iwasaki. 1955. Influence of various chemotherapeutic agents on the action of glutamic acid decarboxylase. *Nagasaki Igakkai Zassi* 30:142-6.
848. Matsuyama, A. 1955. Microbial biosynthesis of pantothenic acid. I. The presumption of the biosynthetic pathway of pantothenic acid by the inhibition analysis. *Nippon Nogei-kagaku Kaishi* 29:730-5.
849. Mat'yakubov, C. M. 1966. Determination of C-reactive protein in patients with bronchial asthma. *Zdravookhr. Turkm.* 8:11-13.
850. Maurel, A., and S. Touye. 1963. Detection and determination of benzoic acid derivatives in wines. *Compt. Rend. Hebd. Seances Acad. Agric. France* 49(2):150-157.
851. Maurice, P. 1957. Preserving tea. *Eng. Pat.* 776,166, June 5.
852. Mayberry, W.R., G.J. Prochazka, and W.J. Payne. 1967. Growth yields of bacteria on selected organic compounds. *Appl. Microbiol.* 15(6):1332-8.
853. Mazzetti, G. 1927. Isomerisms and bactericidal power. I. The bactericidal power of the three oxybenzoic acids: ortho (salicylic acid) meta and para oxybenzoic acid. *Pathologica* 19(434):580-582.
854. McCandlish, A.C., and T.M. Olson. 1921. The possibility of increasing milk and butter fat production by the administration of drugs. *J. Dairy Sci.* 4:474-85.
855. McColl, J. D., J. M. Parker, and J. K. W. Ferguson. 1956a. Evaluation of some 1- and 7-substituted methylated xanthines as diuretics in the rat. *J. Pharmacol. Exptl. Therap.* 118:162-167.

856. McColl, M. D., J. M. Parker, and J. K. W. Ferguson. 1956b. A comparison of the relative toxic, emetic and convulsive actions of a series of methylated xanthine derivatives. *J. Pharmacol. Exptl. Therap.* 116(3):343-350.
857. McDonough, F. E., and R. E. Hargrove. 1968. Heat resistance of salmonella in dried milk. *J. Dairy Sci.* 51(10):1587-1591.
858. McGuire, J., L.A. Pesch, and H. Fanning. 1963. Inhibition of pyridine nucleotide transhydrogenase by dicumarol. *Nature* 200(4901):71-2.
859. McIsaac, W.M. and V. Estevez. 1966. Structure - effect relations of beta-carolins as monaminoxidase inhibitors. *Biochem. Pharmacol.* 15:1625-27.
860. McKinney, G.R. 1951. The effect of certain aromatic compounds on p-amino-hippuric acid synthesis in vitro. *Arch. Intern. Pharmacodynamie* 87:334-8.
861. Mecca, F. 1952. A biochemical method of determining fermentation inhibitors added to wine. *Chimica e Industria* 34:568-70.
862. Medovar, B.Y. 1967. Relation between structure and antioxidant properties of polyphenols. *Vop. Pitan.* 26(2):53-6.
863. Mee, L.K., and G. Stein. 1956. The reduction of cytochrome c by free radicals in irradiated solutions. *Biochem. J.* 62(3):377-380.
864. Meissner, I., and E. Woehlich. 1937. Studies on the action of hydrotropic substances on fibrinogen and blood coagulation. *Biochem. Z.* 293:133-141.
865. Meissner, R. 1926. A simple combined cholera. *Arch. Exp. Pathol. Pharmak.* 115:117-33.
866. Melnick, D., G. A. Perry, and J. Akerboom. 1962. Preserving food. *Eng. Pat.* 904,881, Sept. 5.
867. Menciere, L. 1922. Benzoic, experimental subcutaneous and intravenous injections of benzoic acid and gualacol in man and animals. *Progres Med.* 37:184-185.
868. Melnick, D., H. W. Vahlteich, and A. Hackett. 1956. Sorbic acid as a fungistatic agent for food. II. Effectiveness of sorbic acid for the protection of chicks. *Food Res.* 21:133-146.
869. Merriam, O.A. and C.R. Fellers. 1936. Composition and nutritional value study of blueberries. *Food Res.* 1:501-12.
870. Metcalf, R.L., M. Maxon, T.R. Fukuto, and R.B. March. 1956. Aromatic esterase in insects. *Ann. Entomol. Soc. Am.* 49:274-9; *Bee World* 38:159.
871. Metzzenberg, R.L. and H.K. Mitchell. 1954. Detection of periodate-oxidizable compounds on paper chromatograms. *J. Am. Chem. Soc.* 76:4187.

872. Meunier, P., R. Ferrando, J. Jouanneteau, and G. Thomas. 1949a. The influence of vitamin A on the detoxification of sodium benzoate by the rat. *Compt. Rend.* 228:1254-1256.
873. Meunier, P., R. Ferrando, J. Jouanneteau, and G. Thomas. 1949b. Vitamin A and detoxication phenomena. 1. Influence of vitamin A on the conditions of detoxication of sodium benzoate in the growing rat. *Bull. Soc. Chim. Biol.* 31:1413-1418.
874. Meunier, P., et al. 1949c. Influence of vitamin A on the conditions of detoxication of sodium benzoate by the rat. *Intern. Congr. of Biochem., Abstr. of Commun., 1st Congr., Cambridge, Engl.* 67-68.
875. Meunier, P., R. Ferrando, and G. Perrot-Thomas. 1950. Vitamin A and detoxification appearances. 2. Influence of Vitamin A on the detoxification of brombenzol in rat growth. *Bull. Soc. Chim. Biol.* 32:50-54.
876. Meyer, V. 1964. Biochemical and bacterial causes of marinade swelling and prevention aspects. *Microbial Inhibitors Food, Fourth Int. Sympos. Food Microbiol., Goteborg*, 221-29.
877. Mikeladze, G. G., I. B. Vol'fzdorf, and L. G. Kereselidze. 1967. Application of sorbic acid and sodium benzoate in the production of fruit and berry juices using enzyme preparations. *Ferment. Spirt. Prom.* 33(4):19-21.
878. Miler, M. 1931. Analysis of fruit essences. *Russko-Germanski Westnik Nauki i Techniki* Nr. 9:40-48.
879. Millburn, P., R.L. Smith, and R.T. Williams. 1964. Gall excretion of foreign compounds in the rat. *Biochem. J.* 90(1):Proc. Biochem. Soc. 5P.
880. Miller, G.E., N.C. Banerjee, and C.M. Stowe, Jr. 1967. Diffusion of certain weak organic acids and bases across the bovine mammary gland membrane after systemic administration. *J. Pharmacol. Exp. Ther.* 157(1):245-53.
881. Minami, K. and T. Fukuzumi. 1956. Metabolic products from aromatic compounds by the wood-rotting fungus *Poristictus sanguineus*. 1. Oxidation of benzoic acid and acetaldehyde from its medium. *J. Japanese Forest Soc.* 38(6):225-229.
882. Minibeck, H. 1935. Influence of diet on tests of liver function with benzoic acid. *Ztschr. F. Klin. Med.* 128:491-503.
883. Ministry of Health. London. 1927. Reports on public health and medical subjects. 39, Determination of benzoic acid in foodstuffs. H.M. S.O. 1 s. net.
- * 884. Minor, J. L., and B. A. Becker. 1971. A comparison of the teratogenic properties of sodium salicylate, sodium benzoate, and phenol. *Toxicol. Appl. Pharmacol.* 19:373.

885. Mironava, T. M. 1956. Effect of the mechanical irritation of the receptors of stomach on the carbohydrate metabolism under the action of caffeine before and after an injury of the cerebral cortex of animals. *Vestsi. Akad. Navuk Belarus. S.S.R., Ser. Biyal Navuk* 4:163-180.
886. Mison-Crighel, N., E. Lascar-Constantinescu, and E. Crighel. 1959. The effect of the functional preconvulsion state on the development of convulsion seizures and consequent biochemical changes. *Ukrain. Biokhim. Zhur.* 31:834-847.
887. Mitbander, V.B., J.M. Noronha, D.V. Rege, and A. Sreenivasan. 1962. 4-Dimethylaminoazobenzene-induced hepatoma in rats. I. Certain biochemical alterations in liver and blood. *Indian J. Med. Res.* 50:478-84.
888. Mix, A. E. 1939. Report on (the determination of) benzoate of soda (in foods). *J. Assoc. Official Agr. Chem.* 22:305-307.
889. Moese, J. 1949. Experimental studies on the etiology and prophylaxis of dental caries. *Zeitschr. Stomatol.* 46(1):1-20.
890. Molho, L., D. Molho, and C. Mentzer. 1959. Influence of 3-methylpent-(3)-acid on the biosynthesis of ergosterin by yeast (*Saccharomyces cerevisiae*). *Biochem. Pharmacol.* 1:174-78.
891. Montaz El-Gindy, M. and E. Drews. 1957. Experiences with paper chromatographic detection of preservatives in baked goods. *Brot u. Gebaeck* 11:224-28.
892. Monier-Williams, G.W. 1927. A new method for the determination of benzoic acid in foods. *Analyst* 52:572-5.
893. Monier-Williams, G.W. 1927. Determination of benzoic acid in foodstuffs. *Rev. Pub. Health & M. Subj., No. 39*, pp. 1-57.
894. Monier-Williams, G.W. 1927. Determination of benzoic acid in foodstuffs. *Brit. Food J.* 29:21-23.
895. Monier-Williams, G.W. 1927. Determination of benzoic acid in foodstuffs. *Chemist & Druggist* 106:351-2.
896. Monier-Williams, G.W. 1927. The determination of benzoic acid in foodstuffs. His Majesty's Stationery Office, London. 20 pp. 15 pl.
897. Monselise, J. J. 1967. A rapid method for routine determinations of sodium benzoate and/or potassium sorbate in fruit and vegetable preserved products (letter). *ISR J. Technol.* 5(3):223.
898. Monselise, J. J. 1969. Rapid method for routine determination of sodium benzoate and (or) potassium sorbate in foods. *Israel J. Technol.* 7(3):263.
899. Monselise, J. J., Y. Friedman, R. Fathi. 1970. Improvements to a rapid method for routine determination of sodium benzoate and, or potassium sorbate in foodstuffs. *Israel J. Technol.* 8(5):437-438.

900. Monteiro, H.J. 1961. Constituents of the secretion of *Orthomorpha coarctata*. *Anais Assoc. Brasil. Quim.* 20:29-31.
901. Monti, J. M., and A. J. Hance. 1967. Effects of haloperidol and trifluoperidol on operant behavior in the rat. *Psychopharmacologia* 12(1):34-43.
- * 902. Montoya, R. G. 1970. Combined effects of some local anesthetics with sodium benzoate. *Pharmacology (Basel)* 3(1):1-5.
903. Mordvinkina, T.N. 1967. Changes in adrenal cortex function and incretory function of the stomach in patients with gastric cancer. *Vop. Onkol.* 13(3):38-43.
904. Moretti, P., and N. Corea Manno. 1933. Gastric ulcer treatment with injections of pepsin and sodium benzoate. *Il Morgagni* 74:(48); *Rev. Sudamericana Endocrinol. Inmunol. Quimioterap.* 17:359.
905. Morgan, A. G., C. I. Langston, and A. Field. 1933. Effect of carbon dioxide and sodium benzoate on vitamin C content of orange juice. *Ind. Eng. Chem.* 25:1174-1176.
906. Morgan, D. A., N. B. Rushing, and W. H. Miller. 1954. Effect of carbon dioxide and certain other chemicals on the keeping quality of single-strength and concentrated orange juice. *Proc. Florida State Hort. Soc.* 67:166-170.
907. Morgenstern, S. 1953. Manufacture of antiseptic paper. *Ger. Pat.* 883,557 and 883,558 Kl. 55f, July 20.
908. Moriguchi, I., M. Nayuki, N. Kaneniwa. 1969. Spectroscopic studies on molecular interactions. I. Complexations between caffeine and benzoic acids. *Chem. Pharm. Bull.* 17(7):1339-43.
909. Morimoto, S. and N. Matutani. 1969. Studies on the flavour components of soy sauce. Isolation of furfuryl alcohol and formation of furfuryl alcohol from furfural by yeasts and moulds. *J. Ferment. Technology* 47(8):518-25.
910. Moritani, M., T. Tung, S. Fujii, H. Mito, N. Izumiya, K. Kenmochi, and R. Hirohata. 1954. Specificity of rabbit kidney demethylase. *J. Biol. Chem.* 209(2):485-492.
911. Morse, R. E., 1951. Mode of action of sodium benzoate. *Food Res.* 16:1-9.
912. Mossel, D.A.A., and A.S. de Bruin. 1953. Detection of preservatives in beverages by a fermentation test, with special reference to brominated compounds. *Analyst* 78:37-42.
913. Mossel, D.A.A., and A.S. de Bruin. 1954. A gelatin liquefaction test for the screening of compounds used or proposed as inhibitors of bacterial proteolytic deterioration in foods. *J. Microbiol. Serol.* 20(2):233-240.

914. Mossel, D.A.A. 1954. A specific detection of preservatives in foods by a simple fermentation test with special reference to cured meat products. *Analyst* 79:443-6.
915. Moßsel, D.A.A., and F.D. Tollenaar. 1955. Simple test for occurrence and prevention of microbial lipolytic spoilage in foods. *Leeuwenhoek Ned. Tijdschr.* 21:247-251.
916. Mossel, D.A.A. and F.D. Tollenaar. 1956. A simple test for use in experiments on the occurrence and the prevention of microbial lipolytic spoilage in foods. *J. Sci. Food Agr.* 7:1-288.
917. Mossel, D.A.A., H. Zwart, and A.S. de Bruin. 1960. The presumptive detection of preservatives in canned cured-meat products by a simple yeast-growth test. *Analyst* 85:410-12.
918. Motoike, H. 1958. Biosynthesis of vitamin C. 5. Free and bound vitamin C in rat tissue by accelerators for the formation of glucuronic acid. *Seikagaku (Biochemistry)* 30:215-218.
919. Moudgal, N.R., E. Raghupathy, and P.S. Sarma. 1959. Effect of thyroid imbalance on the detoxication of benzoic acid in the rat. *Endocrinology* 64:326-32.
920. Moustafa, H. H., and E. B. Collins. 1969. Effects of selected food additives on growth of *Pseudomonas fragi*. *J. Dairy Sci.* 52(3):335-340.
921. Mozes, M., O. G. Palffy, A. Antalffy, M. Vitos, and I. Steli. 1968. Periodontopathy in rats after a treatment with drugs acting on the central nervous system. *Rev. Med. (Targu-Mures)* 14(4):417-420.
922. Mrak, E., and W. V. Cruess. 1929. How fruit products corrode metals. *Food Ind.* 1:559-563.
923. Mrozikiewicz, A., A. Mazurowa, and K. Wojciechowski. 1964. Electrocardiographic and histological changes in the heart muscle of rabbits after glutamic acid administration. *Patol. Polska* 15(3):327-338.
924. Mullakhanbhai, M.F. 1968. Degradation of aromatic compounds by *Arthrobacter* species. *J. Indian Inst. Sci.* 50(4):327-44.
925. Munsey, V.E. 1948. Report on the determination of benzoic acid in flour. *J. Assoc. Offic. Agr. Chemists* 31:254-5.
926. Munsey, V.E. 1949. Report on the determination of benzoic acid in flour. *J. Assoc. Offic. Agr. Chemists* 32:255-6.
927. Munsey, V.E. 1950. Report on determination of benzoic acid in flour. *J. Assoc. Offic. Agr. Chemists* 33:166-7.
928. Murdock, L.L., T.L. Hopkins, and R.A. Wirtz. 1970. Phenylalanine metabolism in cockroaches, *Periplaneta americana*: Tyrosine and benzoyl-beta-glucoside biosynthesis. *Comp. Biochem. Physiol.* 36(3):535-545.

929. Mursajew, K. A., Ju. I. Asstachow, and Ss. Ss. Schichalijew. 1964. Use of chemical preservatives in the preparation of fruit and vegetable products. *Konserven- u. Doerrgemuese-Ind. (USSR)* 19(12):8.
930. Myazdrikova, A. A. 1947. Influence of central-nervous-system stimulants on cholinesterase. *Farmakol. i Toksikol.* 10(3):3-6.
- * 931. Nagasawa, K., H. Yoshidome, and R. Takeshita. 1969. Chromatography of food preservatives on polyamide layers and columns. *J. Chromatog.* 43(4):473-79.
932. Nagashima, K. 1921. Pharmacological influencing of uric acid and allantoin excretion. *Acta Schol. Med. Kioto* 4:257-66; *Physiol. Abstracts* 8:320.
933. Nagayama, S. 1956. Acetylcholine metabolism in the heart muscle of dogs. *Nisshin Igaku* 43:10-24.
934. Naguib, M.I. 1965. Effect of benzoic acid and its hydroxy-derivatives on the carbohydrate metabolism of starved and of sucrose-fed etiolated barley leaves. *Planta* 64(1):20-27.
935. Nakamura, Y. 1961. Inhibition of catalase by carboxylic acids related to dissociation and association of the molecule. *Seikagaku* 33:210-16.
936. Nakasima, T., and N. Hasiguti. 1939. The effect of purine bases on the action of adrenaline. *Osaka Igakkai Zasshi* 37:909-920.
937. Nambudiri, A.M.D., P.V. Subba Rao, and J.V. Bhat. 1970. Metabolism of aromatic compounds by an *Alternaria* species. *Phytochemistry* 9(4):687-693.
938. Namiki, M., Y. Okazawa, and A. Matsuyama. 1961. Effect of chemical agents on the irradiation intensification of streptomyciesprotease in the water system. *Agr. Biol. Chem. (Tokyo)* 25:509-14.
939. Nandi, D.N. 1952. Studies on metabolism in schizophrenia: a study on the liver function with the Quick et al. benzoic acid test (1938). *Indian J. Med. Res.* 40:303-11.
940. Narafu, T., J. Hayakawa, and M. Yamada. 1964. Determination of food additives by gas chromatographic technique. I. Determination of synthetic preservatives. *Shokuhin Eiseigaku Zasshi* 5(3):194-8.
941. Narafu, T., J. Hayakawa, H. Takahashi, and Y. Ishida. 1967. The determination of food additives by gas chromatography. *Shokuhin Eiseigaku Zasshi* 8(4):351-7.
942. Narafu, T., J. Hayakawa, H. Takahashi, Y. Ishida, and T. Tsuiki. 1969. Determination of food additives by gas chromatography. II. Simultaneous determination of synthetic preservatives by programmed temperature gas chromatography. *Shokuhin Eiseigaku Zasshi* 10(3):186-9.

- * 943. NAS/NRC Questionnaire.
- 944. Nauen, F. 1933. Relation between swelling and proteolysis in the collagen. *Biochem. Z.* 231:441-45.
- 945. Negri, C. 1934. Effects of parenteral administration of neutral pepsin and sodium benzoate; clinical and experimental research on mechanism of cation, with special reference to changes in chemistry of blood. *Gior. di Clin. Med.* 15:107-127.
- 946. Neidig, C.P., and H. Burrell. 1944. Esters of p-hydroxybenzoic acid as preservatives. *Drug. Cosmetic Ind.* 54:408-10, 481-9.
- 947. Neidlinger, J. S., C. A. Kempf, and A. P. Stewart, Jr. 1952. Adaptation of the Barker-Summerson lactic acid method to ice cream and ingredients for ice cream. *J. Dairy Sci.* 35:305-313.
- 948. Neill, D.W., and J.A. Weaver. 1959. A study of some metabolic processes dependent on coenzyme "A" in pernicious anaemia. *Acta Haematol.* 21(1):23-30.
- 949. Nelson, E.K. 1927. The non-volatile acids of pear, quince, apple, loganberry, whortleberry, cranberry, lemon and pomegranate. *J. Am. Chem. Soc.* 49:1300-1302.
- 950. Nesheim, M.C., and J.D. Garlich. 1963. Ornithine synthesis in relation to benzoic acid excretion in the domestic fowl. *J. Nutr.* 79(3):311-317.
- 951. Neuberg, J. 1924. The metabolism of benzoic acid in the human organism. *Biochem. Z.* 145:249-73.
- 952. Newburgh, L.H., and P.L. Marsh. 1925. Kidney damage from amino acids. *Arch. Intern. Med.* 36:682-711.
- 953. Nicholas, J.A., C.J. Umberger, F. Fiorese, and P.D. Wilson. 1958. Spectrophotometric urinary curves in persons after bone and joint operations. *Surgery, Gynecol. Obstetr.* 107:489-494.
- 954. Nicholls, J.R. 1928. Determination of small quantities of benzoic and cinnamic acids with some notes on the colorimetric determination of salicylic acid. *Analyst* 53:19-29.
- 955. Nicholls, J.R. 1933. Determination of benzoyl peroxide in flour. *Analyst* 58:4-7.
- 956. Niebroj, T. 1958. Perfusion of the liver with a saturated solution of silicic acid containing some inhibitors of silicotic changes. *Patologia Polska* 9:377-380.
- 957. Nikkila, O.E. 1955. Bacteria found in spoiled herring preserves and their behavior toward salt and preservatives. *Fette, Seifen, Anstrichmittel* 57:494-98.

958. Nikkila, O.E., and R.R. Linko. 1958. Chemical preservatives in foods. II. The effect on molds. *Maataloustieteellinen Aikakauskirja* 30:125-31.
959. Nishimoto, T., M. Uyeta, S. Taue, and I. Takebayashi. 1968a. Bacterial formation of benzoic acid in milk. *Shokuhin Eisengaku Zasshi* 9(1):58-59.
960. Nishimoto, T., M. Uyeta, and S. Taue. 1968b. Detection of benzoic acid in fermented milk. *Shokuhin Eisengaku Zasshi* 9(1):60-2.
961. Nishimoto, T., M. Uyeta, and S. Taue. 1969. The precursor of benzoic acid in fermented milk. *J. Food Hyg. Soc. Jap.* 10(6):410-413.
962. Nishimura, K. and Y. Hirose. 1964. The aroma constituents of Kogyoku apple. *Agr. Biol. Chem. (Tokyo)* 28(1):1-4.
963. Nishizawa, Y., T. Kodama, and T. Kumagai. 1958. The running fit-inciting action of carbonyl reagents. *J. Vitaminol.* 4(2):138-148.
964. Nisonoff, A., and D. Pressman. 1958. Heterogeneity of antibody sites in their relative combining affinities for structurally related haptens. *J. Immunol.* 81:126-35.
965. Nobe, B., and R. L. Stanley. 1965. Gas-chromatographic determination of sodium benzoate in meat. *J. Assoc. Offic. Agr. Chemists* 48(4):791-793.
966. Noetzel, O. 1927. The determination of benzoic acid. *Z. Untersuch. Lebensm.* 53:383-7.
967. Nogami, H., M. Hanano, and H. Yamada, 1968. Absorption and excretion of drugs. IX. Relation between chemical structure and absorption rate. 1. Effects of the number and the position of hydroxyl groups on the intestinal absorption rate of benzoyl derivatives. *Chem. Pharm. Bull. (Tokyo)* 16(3):389-394.
968. Nurmikko, V. 1955. Application of the symbiosis phenomenon between milk acid bacteria to the study of growth factor biosynthesis. *Suomalaisen Tiedeakatemia Toimituksia (Ann. Acad. Sci. Fennicae) Sarja A. II. Nr.* 60:216-25.
969. N.V. Internationale Oxygenium Maatschapij Novadel. 1930. Treatment of flour and flour products. *Fr. Pat.* 672,627, Jan. 4.
970. Nyeste, L., and M.P. Geher. 1961. Effect of activating and inhibiting compounds on the polygalacturonase components of *Aspergillus niger*. *Elelmezési Ipar (Food Ind.)* 15:84-89.
971. Nyiredy, I., and A. Bakos. 1940. The detection of benzoic acid and its derivatives in processed cheese. *Mezogazdasági Kutatasok* 13:284-7.

972. Oakley, M. 1955. Analysis of preservatives and artificial sweeteners. J. Assoc. Offic. Agr. Chemists 38:552-4.
973. Ochsenfahrt, H., and D. Winne. 1969. The influence of blood flow in the absorption of drugs from the jejunum of the rat. Naunyn-Schmiedebergs Arch. Pharmakol. Exp. Pathol. 264(1):55-75.
974. O'Connor, M.G., A.S. Levine, C.R. Fellers, and F.P. Griffiths. 1943. The preservative properties of benzoic acid and its salts. J. Bact. 45(1):37.
975. Oda, Y. 1951. Mechanism of enzymic adaptation. V. Interaction between enzyme-forming systems in enzyme synthesis and metabolic selection. Med. J. Osaka Univ. 2:397-406.
976. Ogawa, E., S. Suzuki, K. Shibata, T. Honma, K. Sadakata, and H. Tsuzuki. 1966. Experimental studies on the distribution of C14-barbital. Gunma J. Med. Sci. (Japan) 15(4):201-207.
977. Ohta, T., M. Nakano, and H. Hieda. 1964. Effect of different preservatives on the storage ability of vinegar. Rep. Food Res. Inst. (Tokyo) Nr. 18:36-39.
978. Oka, S. 1960. Transfer of antiseptics to microbes and their toxic effect. I. Accumulation of acid antiseptics in yeast cells. Bull. Agr. Chem. Soc. Japan 24:59-65.
979. Oka, S. 1960. Transfer of antiseptics to microbes and their toxic effect. II. Relation between adsorption of acid antiseptics in yeast cell and their toxic effect. Bull. Agr. Chem. Soc. Japan 24:338-43.
980. Oka, S. 1964. Mechanism of antimicrobial effect of various food preservatives. Intern. Symp. Food Microbiol., 4th, Goteborg, Swed. 3-16.
981. Okada, M. 1928. The action of some diuretics and other drugs on the glomeruli. Okayama-Igakkai-Zasshi 40:717-725.
982. Okamoto, K. 1955. Experimental pathology of diabetes mellitus. Tohoku J. Exptl. Med. 61(Suppl. 3), 116 pp.
893. Okamoto, T. 1967. Gas-chromatographic studies on the food preservatives in soy sauce and some foods containing soy sauce. Kagawa-Ken Hakko Shokuhin Shikenjo Hokoku, 59:40-6.
984. Okey, R.W., and R.H. Bogan. 1965. Apparant changes by the electronic mechanism in the inhibition of the microbial metabolism of pesticides. J. Water Pollut. Control Federat. 37:692-712.
985. Oki, T. 1958. The action of xanthine derivatives on respiration, blood pressure, and coronary blood vessels. Igaku Kenkyu 28:2017-2030.

986. Okitsu, T., and K. Yamada. 1955. Effect of mixed antiseptics on the retardation of bacterial growth. *Bull. Japan. Soc. Sci. Fisheries* 20:1010-14.
987. Okumura, K., K. Ashino, and T. Okuda. 1961. Novobiocin and related compounds. 7. Antimicrobial action of Novobiocin related compounds and their components. *J. Pharmac. Soc. Japan* 81:1482-88.
988. Okunuki, K., B. Hagihara, H. Matsubara, and T. Nakayama. 1956. Denaturation and inactivation of enzyme proteins. I. Bacterial proteinase method for the determination of the ratio of denaturation of globular proteins. *J. Biochem. (Japan)* 43:453-67.
989. Okunuki, K., B. Hagihara, I. Sekuzu, T. Shibata, M. Nozaki, F. Hattori, H. Matsubara, and T. Yonetani. 1954. Denaturation and inactivation of enzyme protein. II. Effect of various inhibitory reagents on enzymes. *Symposia on Enzyme Chem. (Japan)* 10:143-150.
990. Okura, N. 1961. The absorption of iron from intestines, especially in abnormal conditions of albumin metabolism. *Nippon Ika Daigaku Zasshi* 28:105-13.
991. Olejnicek, H., and F. Hanzelka. 1934. Detection of benzoic acid in wine. *Chem. Obzor* 10:185-8., 211-14, 214-15.
992. Oliveira Barrosa, M. T. de. 1963. Determination of injectable caffeine-sodium benzoate by ultraviolet spectrophotometry. *Rev. Port. Farm.* 13(4):491-493.
993. Opienska-Blauth, J., O. Saklowska-szymonowa, and M. Kanski. 1951. The partition paper chromatography of some organic acids. *Ann. Univ. Mariae Curie-Sklodowska, Sect. D-Med* 5(9):221-275.
994. Orlando, I. E., and G. D'Antuono. 1956. Behavior of blood glycine and of urinary hippuric acid after simultaneous intravenous administration of sodium benzoate and glycine. *Arch. Patol. e Clin. Med.* 33:381-393.
995. Osman, H.G., and A. El-Mariah. 1960. Studies on the inhibitory effect of combined chemical preservatives on *Saccharomyces cerevisiae*. *J. Am. Pharm. Assoc., Pract. Pharm. Ed.* 49:231-3.
996. Osstaschkow, K.W. 1956. Influence of caffeine and bromine on the exhaustion and regeneration in the spinal chord. *Physiol. J. (Kiew)* 2(2):25-32.
997. Osterwalder, A. 1929. The significance of benzoic acid and sodium benzoate in the preparation of non-alcoholic fruit wines. *Landw. Jahrb. Schweiz* 43:97-119.
998. Osterwalder, A. 1930. Studies on the mushroom-killing effect of sodium benzoate in fruit juices. *Landwirtschl. Jahrbch. Schweiz* 44:519-21.

999. Ottey, L. 1955. Effect of purine and pyrimidine analogs on enzyme induction in *Mycobacterium tuberculosis*. J. Pharmacol. Exptl. Therap. 115:339-42.
1000. Ottey, L., and F. Bernheim. 1956. A comparison of the factors which affect the formation of adaptive enzymes for benzoic acid and inositol in a *Mycobacterium*. Enzymologia 17(5/6):279-285.
1001. Ozawa, Y. 1953. The fungistatic effect of dehydroacetic acid added to margarine. Bull. Natl. Inst. Agr. Sci. (Japan), Ser. G. 5:17-20.
1002. Paasonen, M. K., and M. Vogt. 1956. The effect of drugs on the amounts of substance P and 5-hydroxytryptamine in mammalian brain. J. Physiol. (London) 131:617-626.
1003. Pace, D. M., B. Th. Aftonomos, A. Elliott, and S. Sommer. 1967. Effects of the sodium salts of certain monocarboxylic acids on established cell lines. Can. J. Biochem. 45(1):81-88.
1004. Palladina, O. K. 1935. The stability of margarine. Bakteriolog. Technol. Margarine 83-105.
1005. Papanicolaou, N. I. 1966. Preparation of green table olives. Chim. Chron. 31(10):147-153.
1006. Parkinson, T.L. 1952. The use of paper chromatography in the detection of benzoic acid and its derivatives in foods. Analyst 77:438-39.
1007. Patel, R.P., and A.B. Shah. 1965. Disodium salt of EDTA as an antimicrobial substance. Indian J. Pharmacy 27:147-48.
1008. Pazderova, J., et al. 1964. Importance of determining benzoic acid in the urine for the diagnosis of acute toluene poisoning. Prac. Lek. 16:21-4.
1009. Pedersen, A. H., A. Moller-Madsen, H. E. Birkkjaer, and N. J. T. Jespersen. 1951. The control of mold on cheese. Food Sci. Abstr. 26:634.
1010. Pederson, C.S., M.N. Albury, and M.D. Christensen. 1961. Growth of yeasts in grape juice stored at low temperature. IV. Fungistatic effects of organic acids. Appl. Microbiol. 9(2):162-7.
1011. Pederson, C. S., and D. K. Tressler. 1938. Bottle pasteurizing of apple juice. Ind. Engng. Chem. 30:954-959.
1012. Penniall, R., G. Kalnitsky, and J. I. Routh. 1956. The effects of salicylic acid and related compounds on in vitro rat brain respiration. Arch. Biochem. 64:390-400.

1013. Peretianu, J., A. Sporn, J. Heilpern, and M. Chane. 1956. The effect of benzoic acid upon the development and reproduction of the white rat and upon the recovery of hepatic-protein content. *Igiene (Bucharest)* 3:33-47.
1014. Perigo, J.A., B.L. Gimbert, and T.E. Bashford. 1964. The effect of carbonation, benzoic acid and pH on the growth rate of a soft drink (citrus-beverage) spoilage yeast as determined by a turbidostatic continuous culture apparatus. *J. Appl. Bacteriol.* 27(2):315-332.
1015. Perrin, M., P. Briquel, and G. Castelain. 1937. Accidents following intravenous injections of sodium benzoate in therapy of various lung diseases; cases. *Rev. Med. de Nancy* 65:922-923.
1016. Peters, K. W., et al. 1969. Effect of food preservatives on the survival rate of rats following whole-body irradiation. 1. Hexamethylene tetramine, 2. Na-benzoate, 3. Nipagin-M (methylene ester of paraoxybenzoic acid). *Strahlentherapie* 138:724-732.
1017. Pfrimmer, J. & Co. 1964. Sterilization of surgical yarns. *Neth. Appl.* 6,400,695; *Ger. Appl.* Jan. 31, 1963.
1018. Pick, L. 1931. Detection of benzoic acid as methyl ester. *Z. Untersuch. Lebensm.* 61:358.
1019. Piettre, M. 1933. Use of benzoic acid in protective covering of meat products. *Ann. Hyg.* 11:134-137.
1020. Pijanowski, E. 1950. Investigation on the technology of fruit and vegetable products. *Przemyst Rolny i Spoz.* 4(12):396-405.
1021. Pikaar, H.R. 1965. Compositions for cleaning egg shells. U.S. Pat. 3,211,659.
1022. Pilcher, C., C. P. Wilson, and T. R. Harrison. 1927. The action of drugs on cardiac output. III. The effect of caffeine sodiobenzoate on the cardiac output of dogs. *Am. Heart J.* 2:618-629.
1023. Pinella, S.J., A.D. Falco, and G. Schwartzman. 1966. Determination of benzoates and hydroxybenzoates in foods. *J. Assoc. Offic. Anal. Chemists* 49(4):829-34.
1024. Pinzon, R., and I. Kapetanidis. 1965. Separation and identification of six preservatives by thin-layer chromatography. Qualitative study of two galenic preparations. *Mikrochim. Ichnoanalyt. Acta (Wien)* 269-73.
1025. Pizzolato, P., and H. H. Beard. 1942. The effect of administering cyanamide, guanidine acetate and sodium benzoate, with and without amino acids, upon the creatine content of rat muscle. *Arch. Biochem.* 1:187-190.

1026. Planella, I. 1963. Preservation of fillets from *Merluccius gayi* by chlortetracycline, sodium benzoate, and potassium sorbate. *Nutr.-Bromatol. Toxicol.* 2(4):161-166.
1027. Platon, B., G. Emgard, and T. Olsson. 1940. Prevention of mold growth on cheese during storage. *Svenska Mejeritidn* (46/47):1-10.
1028. Poe, C. F., M. Cooley, and N. F. Witt. 1933. Influence of certain preservatives on the determination of cane sugar by the inversion method. *Ind. Engng. Chem. Analyt. Edit.* 5:309-310.
1029. Poe, C. F., R. C. Meehan, and B. H. Lincoln. 1929. Chemical changes accompanying the fermentation of apple juice with and without the addition of sodium benzoate. *Univ. Colorado Studies* 17:1-16.
1030. Poe, C. F., R. C. Meehan, and B. H. Lincoln. 1932. Fermentation of apple juice with and without addition of sodium benzoate accompanying chemical conversion. *Fruit Products J. Am. Vinegar Ind.* 12:6-10.
1031. Poe, C.F., J.G. Strong, and N.F. Witt. 1937. The toxicity of certain codeine compounds for male and female rats of different ages. *J. Pharmacol.* 61:62-5.
1032. Ponder, E. 1921. Method for investigating the hemolytic activity of chemical substances. *Proc. Roy. Soc. London* 92B:285-95.
1033. Pope, H. 1954. Influence of benzoate and salicylate on the oxidative metabolism of *Mycobacterium tuberculosis*. *Am. Rev. Tubercul.* 69:705-09.
1034. Popoff, M. 1923. Cellular stimulants and the theoretical foundation of their action. *J. Physiol. Path. Gen.* 21:482-92.
1035. Power, F.W., and C.P. Sherwin. 1927. The detoxication of putrefactive products by the human body. *Arch. Internal Med.* 39:60-6.
1036. Pozzi, A., and L. Sforza. 1933. Treatment of gastro-duodenal ulcers with sodium benzoate. *Rev. Sudamericana Endocrinol. Immunol. Quimioterap.* 17:272.
1037. Prah, L., R. Engst, and E. Jarneatz. 1968. Analysis of preservatives. I. Isolation and separation by thin-layer chromatography. *Nahrung* 12(8):845-51.
1038. Pressman, D., A. Nisonoff, and G. Radzimski. 1961a. Specific anion effects with antibenzoate antibody. *J. Immunol.* 86:35-41.
1039. Pressman, D. A. Nisonoff, G. Radzimski, and A. Shaw. 1961b. Nature of the active site of antibenzoate antibodies: Further evidence for the presence of tyrosine. *J. Immunol.* 86:489-495.
1040. Pressman, D. and L. Pauling. 1949. The reactions of antiserum homologous to the 4-azophthalate ion. *J. Am. Chem. Soc.* 71:2893-9.

1041. Pressman, D., M. Siegel, and L.A.R. Hall. 1954. The closeness of fit of antibenzoate antibodies about haptens and the orientation of the haptens in combination. *J. Am. Chem. Soc.* 76:6336-41.
1042. Pressman, D., and M. Siegel. 1957. The hydration of the annular nitrogen group as a factor in the combination of hapten with antibody. *J. Am. Chem. Soc.* 79:994-1000.
1043. Pribela, A., and F. Strmiska. 1965. Application of gas chromatography during the determination of some preservatives. *Sb. Prac. Chem. Fak. SVST (Slov. Vysokej Skoly Tech.)* 125-31.
1044. Primo Yufira, E., J. Sanchez, and J. Alberola. 1963. Detection of adulterations in citrus juices. I. Methods for the identification of acids in orange juice by thin-layer chromatography and gas-liquid chromatography. *Rev. Agroquim. Tecnol. Alimentos* 3:346-49.
1045. Primo, E., J. Sanchez, and J. Alberola. 1965. Detection of citric juice adulteration. 3. Identification of non-volatile acids in American orange juices. *Rev. Agroquim. Tecnol. Alimentos* 5:121-24.
1046. Primo, E., J. Sanchez, and J. Alberola. 1965. Detection of citric juice adulteration. 4. The fermentation citric acids of contaminating non-volatile acids and amino acids. *Rev. Agroquim. Tecnol. Alimentos* 5:211-15.
1047. Primo, E., A. Casas, J. Alberola, M. Martinez, and M.P. Cornejo. 1969. Detection of citrus juice adulteration. XV. Identification of carboxylic acids present in orange juice, commercial sucrose and citric acid by gas-liquid (GLC) and thin layer chromatography (TLC). *Rev. Agroquim. Technol. Alimentos* 9(3):415-422.
1048. Prior Ferraz, F.G., and M.E. Relvas. 1965. Separation and identification of organic acids in biological media by column and gas phase chromatography. *Clin. Chim. Acta* 11(3):244-58.
1049. Probst, J. G., and S. Londe. 1942. Hepatic function and the formation of hippuric acid. Response to the administration of aminoacetic acid and sodium benzoate in patients with subnormal capacity for synthesis. *Arch. Surg.* 45:253-260.
1050. Prochazka, G.J., W.R. Mayberry, and W.J. Payne. 1966. Model systems for studying energy yields from synthetic organic compounds. *Develop. Ind. Microbiol.* 8:167-78.
1051. Prosic, Z. A., D. G. Bogojevski, and A. F. Damanski. 1965. Effect of various preservatives on nitrogen-free and nitrogen-containing substances in the storage of tomatoes. *Nahrung* 9(1):53-61.
1052. Pruthi, J. S., and G. Lal. 1951. Preservation of citrus fruit juices. *J. Sci. Ind. Res. (India)* 10B:36-41.

1053. Pruthi, J.S., B.A.S. Rao, and G.S. Siddappa. 1963. Determination of the optimal dose of chemical preservative of cashew apple fruit and juice. *Sci. Cult. (Calcutta)* 29(8):416.
1054. Pruthi, J. S., G. L. Tandon, N. L. Jain, and C. P. Natarajan. 1952. Ascorbic acid and color changes in citrus-fruit juices during processing. *J. Sci. Ind. Res. (India)* 11A:32-34.
1055. Puhlmann, H. 1939. *Arch. Exp. Path. u. Pharmacol.* 193(2):136-151.
1056. Puls, D.D., L.F. Lindgren, and F.P. Cosgrove. 1955. Sorbic acid as a fungistatic agent in certain pharmaceutical preparations. *J. Am. Pharmac. Assoc. Sci. Edit.* 44:85-87.
1057. Quartley, J.S., and D.A.L. Seiler. 1958. Preserving tea. *Australian Pat.* 218,153, Nov. 20.
1058. Quastel, J. H., and W. T. Wales. 1940. Faulty detoxication in schizophrenia. Abnormal excretion of hippuric acid after administration of sodium benzoate. *Lancet* 1:402-403.
1059. Quastel, J.H., and A.H.M. Wheatley. 1935. Studies in fat metabolism. 4. Acetoacetic acid breakdown in the kidney. *Biochem. J.* 29(12):2773-2786.
1060. Quick, A.J. 1926. The study of benzoic acid conjugation in the dog with a direct quantitative method for hippuric acid. *J. Biol. Chem.* 67(2):477-490.
1061. Quick, A.J. 1926a. The production of conjugated glycuronic acids in depancreatized dogs. *J. Biol. Chem.* 70(1):59-69.
1062. Quick, A.J. 1926b. Origin of glycuronic acid in the organism. *J. Biol. Chem.* 70:397-404.
1063. Quick, A.J. 1928. Quantitative studies of b-oxidation. I. The conjugation of benzoic acid and phenylacetic acid formed as the end-products from the oxidation of phenyl-substituted aliphatic acids. *J. Biol. Chem.* 77(2):581-593.
- * 1064. Quick, A. J. 1931. Conjugation of benzoic acid in man. *J. Biol. Chem.* 92(1):65-85.
1065. Quick, A.J. 1932a. The conjugation chemistry of benzoic acid. *J. Biol. Chem.* 95:189-96.
1066. Quick, A.J. 1932b. Location of hippuric acid and phenaceturic acid formation in the dog. *J. Biol. Chem.* 96:73-81.
- * 1067. Quick, A. J. 1932c. The relationship between chemical structure and physiological response. III. Factors influencing the excretion of uric acid. *J. Biol. Chem.* 98:157-169.
- * 1068. Quick, A. J. 1932d. Conjugation of benaoic acid with glycine, a test of liver function. *Proc. Soc. Exptl. Biol. Med.* 29:1204-1205.

1069. Quick, A.J. 1935. The effect of exercise on the excretion of uric acid. With a note on the influence of benzoic acid on uric acid elimination in liver diseases. *J. Biol. Chem.* 110:107-12.
1070. Quick, A.J. 1944. Toxicity of sodium benzoate. *J.A.M.A.* 124:1219-1220.
1071. Quick, A.J., and M.A. Cooper. 1932. Effect of liver injury on conjugation of benzoic acid in dog. *J. Biol. Chem.* 99:119-124.
1072. Quick, A.J., H. N. Ottenstein, and H. Weltchek. 1938. Synthesis of hippuric acid in man following intravenous injection of sodium benzoate. *Proc. Soc. Exp. Biol. Med.* 38(1):77-78.
1073. Rabinowitz, H.M. 1946. Antipressor. U.S. Pat. 2,392,878.
1074. Radies-Atjai, I., and E.S. Arato. 1965. Determination of hippuric acid and free benzoic acid in urine. *Munkavedelem* 11(7-9):32-7.
1075. Radkevich, T.P., E.N. Padeiskaya, and G.N. Pershin. 1968. Quinoxidine activity in experimental meningitis of rabbits induced by *Pseudomonas pyocyanea*. *Farmakol. Toksikol.* 31(3):299-305.
1076. Radwan, A.G., and G.B. West. 1968. The effect of nonsteroidal antiinflammatory drugs on histamine formation in the rat. *Brit. J. Pharmacol. Chemother.* 33(1):193-8.
1077. Rafalowicz, A. 1963a. The carbazole method applied for the determination of glucuronic acid in body fluids. III. The excretion of glucuronic acid in healthy people after sodium benzoate loading. *Med. Dosw. Mikrobiol.* 15(4):345-348.
1078. Rafalowicz, A. 1963b. The carbazole method in the determination of glucuronic acid in biological fluids. III. Studies on the excretion of glucuronic acid following the administration of sodium benzoate in normal subjects. *Med. Dosw. Mikrobiol.* 15:349-358.
1079. Rafalowicz, A. 1963c. Glucuronic acid excretion in urine after sodium benzoate loading: A liver functional test. *Med. Dosw. Mikrobiol.* 15(4):359-364.
1080. Rafalowicz, A., M. Kowalczyk, and J. Lyczewska. 1964. Synthesis and urinary excretion of glucuronides in epidemic hepatitis and obstructive icterus. *Polskie Arch. Med. Wewnętrznej* 34(4):441-448.
1081. Rahn, O., and J.E. Conn. 1944. Effect of increase in acidity on antiseptic efficiency. *Indust. and Engineer. Chem., Indust. Ed.* 36(2):185-187.
1082. Raible, K. 1955. Studies on chemical preservation of food egg yolk. *Zbl. Bakteriolog., Parasitenkunde, Infektionskrankh. Hyg. I. Abt. Orig.* 164:80-82.

1083. Raible, K. 1957a. Effect of sub-threshold concentrations of chemical preservatives on the growth and fermentation of yeast in maltwort. Deut. Lebensm.-Rundschau 53:60-64.
1084. Raible, K. 1957b. Effect of the initial concentration of yeast cells on the effectiveness of chemical preservatives in malt-wort. Deut. Lebensm. Rundschau 53:155-156.
1085. Raible, K. 1957c. Influence of test microbe culture age on the action of chemical preservatives. Dtsch. Lebensmittel-Rdsch. 53:198-200.
1086. Raible, K., and G. Busch. 1957. Studies on chemical preservatives. I. The influence of subliminal preservative concentrations on the multiplication of yeast. Zbl. Bakteriologie, Parasitenkunde, Infektionskrankh. Hyg. II. Abt. 110:172-77.
1087. Rajama, J., and P. Makela. 1969. Test-tube extraction method for the determination of benzoic and sorbic acids in fruit juices. Lab. Pract. 18(2):149-51.
1088. Raman, T.S., and E.R.B. Shanmugasundaram. 1962. Transformation of aromatic acids by *Aspergillus niger*. J. Bacteriol. 84:1339-40.
1089. Ramusino, F.C., R. Intonti, and A. Stacchini. 1961. Analysis of almond milk and barley syrup. Boll. Lab. Chim. Provinc. 12:491-504.
1090. Randall, W.W. 1926. Report on the determination of food preservatives. J. Assoc. Official Agr. Chem. 9:358-61.
1091. Randall, W.W. 1927. Report on the determination of food preservatives. J. Assoc. Official Agr. Chem. 10:414-24.
1092. Randall, W. W. 1928. Report on (the determination of) food preservatives. J. Assoc. Official Agr. Chem. 11:429-433.
1093. Rao, M. S.S., and D. S. Johar. 1959. Inhibitory effect of acetic acid and sodium benzoate on the growth of two strains of osmophilic yeast. Food Sci. 8:383-386.
1094. Rapport, D. 1924. Animal calorimetry. J. Biol. Chem. 60:497-601.
1095. Rathenasinkam, E. 1952. Detection of benzoic acid in foods. Analyst 77:101-2.
1096. Rathenasinkam, E. 1962. Sublimation of benzoic acid. Analyst 87:298-9.
1097. Rediger, B., and I. Perenyi. 1956. Possibility elimination of boric acid poisoning in pediatrics by the use of benzoates. Gyogyszeres 11:165-166.
1098. Rehm, H.J. 1959. Action of preservative combinations. II. The action of simple preservative combinations on *Escherichia coli*. Z. Lebensm.-Untersuch. Forsch. 110:356-63.

1099. Rehm, H.J., and U. Stahl. 1959. Action of antimicrobial substances in combination. *Naturwissenschaften* 46:431-2.
1100. Rehm, H.J. 1960. Antimicrobial activity of mixtures of agents used for the preservation of liquids. *Ann. Inst. Pasteur Lille* 11:217-26.
1101. Rehm, H.J., and U. Stahl. 1960. Action of preservative combinations. III. Action of simple preservative combinations on *Aspergillus niger* and *Saccharomyces cerevisiae*. *Z. Lebensm.-Untersuch. Forsch.* 113:34-47.
1102. Rehm, H.J. 1960. Action of preservative combinations. IV. Action of simple combinations of preservatives with some antibiotics on *Escherichia coli*. *Z. Lebensm.-Untersuch. Forsch.* 113:144-52.
1103. Rehm, H.J. 1961. Action of preservative combinations. V. The resistance of microorganisms to preservative combinations. *Z. Lebensm.-Untersuch. Forsch.* 115:27-46.
1104. Rehm, H.J., H. Wittmann, and U. Stahl. 1961. Action of preservative combinations. VI. Antimicrobial spectrum with combinations of preservatives. *Z. Lebensm.-Untersuch. Forsch.* 115:244-62.
1105. Rehm, H.J. 1961. Limiting inhibiting concentration of preservatives against microorganisms. *Z. Lebensm.-Untersuch. Forsch.* 115:293-309.
1106. Rehm, H.J. 1963. Influence of chemical compounds on the antimicrobial preservatives. I. Influence of various types of compounds on the preservative action against *Aspergillus niger*. *Z. Lebensm.-Untersuch.-Forsch.* 118:508-22.
1107. Rehm, H.J., E.M. Lukas, and F. Senser. 1964. Action of preservative combinations. VIII. Action of binary combinations of preservatives on further antibiotics. *Z. Lebensmittel-Unters. Forsch.* 124:437-47.
1108. Rehm, H.J., F. Senser, and E.M. Lukas. 1964. Action of preservative combinations. IX. Action of binary and ternary combinations of preservatives with nisin and tylosin. *Z. Lebensm.-Untersuch. Forsch.* 125(4):258-71.
1109. Rehse, K. 1967. Analysis of pharmaceuticals by nuclear magnetic resonance. Detection and determination of methylxanthines in the presence of sodium salicylate and sodium benzoate. *Deut. Apoth.-Ztg.* 107(43):1530-1533.
1110. Reid, R. D., L. C. Felton, and M. A. Pittroff. 1946. Prolongation of penicillin activity with penicillinase-inhibiting compounds. *Proc. Soc. Exptl. Biol. Med.* 63(2):438-443.
1111. Reimers, F. 1941. Investigation of microchemical methods. IV. Identification by means of microdetermination of refraction. *Dansk Tijds. Farm.* 15:81-99.

1112. Reindollar, W.F. 1944. Report on the determination of food preservatives and artificial sweeteners. *J. Assoc. Official Agr. Chem.* 27:256-7.
1113. Reinwein, H., and H. Heinlein. 1924. The composition of fruit water. *Ztschr. Biologie* 81:283-90.
1114. Reiss, G. 1927. Preservatives allowed in foodstuffs in Germany. *Reichsgesundheitsblatt* 2:359-61.
1115. Retterer, D. 1944. The preservation of wines in the year 1944. *Progres. Agr. Vit.* 121:66-69; *Chem. Zentr.* 11:177.
1116. Reuszer, H. W. 1939. The effect of benzoic acid compounds upon the abundance of microorganisms, including *Azotobacter* organisms, in a soil. *Trans. Third Comm. Internat. Soc. Soil Sci. Vol. A.* 151-160.
1117. Rieder, H. P. 1955. Normal values for Quick's hippuric acid test and their dependence on urinary volume. *Helvetica Med. Acta* 22(3):210-227.
1118. Riggs, T.R., and H.N. Christensen. 1951. Conjugation of p-aminobenzoic acid in rat metabolism. *J. Biol. Chem.* 193:675-81.
1119. Rivers, S.M., et al. 1966. The effect of benzoic acid, phenol and hydroxybenzoates on the oxygen uptake and growth of some lipolytic fungi. *J. Pharm. Pharmacol.* 18(Suppl):45-51.
1120. Rjasanowa-Ssolnzewa, M. Ss. 1960. Influence of sulfanilamide preparations on the electrical sensitivity of visual analysor in man and the bioelectrical activity of animal brains. *Wiss. Hochschulber., Biol. Wiss. (USSR)* 3:75-80.
1121. Roberts, A. 1951. Substances that prevent kidney excretion of chemotherapeutic substances. *Australas. J. Pharmac.* 32:943-44.
1122. Robinson, H. 1954. Manufacture of benzoic acid and benzoates. *Perfum. Essent. Oil Rec.* 45:227-229.
1123. Roche, G.W., and H.N. Wright. 1953. Systematic toxicological analysis by spectrophotometer methods. I. Non-alkaloidal organic compounds. *Arch. Indust. Hyg. Occup. Med.* 8(6):507-517.
1124. Roehr, M., and W. Hampel. 1966. Induced synthesis of aminocyclase in *Fusarium*. *Mh. Chem.* 97:1787-1796.
1125. Roholt, K. 1946. Effect of benzoic acid and benzoic acid derivatives on growth of *Streptobacterium plantarum* and *Saccharomyces cerevisiae*. *Compt. Rend. Trav. Lab. Carisberg, Serie Physiol.* 24:172-177.
1126. Romanescu, G., M. Pleceas, and A. Ichim. 1964. The effect of certain compounds on the influenza virus. *Igiena (Bucharest)* 13(1):27-32.

1127. Romanyuk, S.L. 1963. Influence of corticosteroid hormones on the antitoxic function of the liver. *Terapevt. Arkh.* 35(3):30-3.
1128. Roos, J.B., and A. Versnel. 1959. Spectrophotometric method for determining benzoic acid in margarine. *Chem. Weekblad* 55:67-9.
1129. Roos, J.B., and A. Versnel. 1960. Quick simultaneous spectrophotometric determination of benzoic and sorbic acid in margarine and butter. *Deutsche Lebensm.-Rundschau* 56:128-33.
1130. Rosen, D. 1957. Effects of gamma rays on solutions of human serum albumin. I. Sedimentation studies. *Arch. Biochem. Biophys.* 70(1):266-276.
1131. Rosen, H., A. Leaf, and W.B. Schwartz. 1964. Diffusion of weak acids across the toad bladder. Influence of pH on nonionic permeability coefficients. *J. Gen. Physiol.* 48(2):379-89.
1132. Rosenfeld, G. 1927. Do embryonic cells undergo fatty degeneration? *Biochem. Z.* 190:101-108.
1133. Rosenthaler, L. 1929. Microchemical behavior of the official alkaloids. *Am. J. Pharm.* 101:821-829.
1134. Rosenthaler, L. 1942. Detection of organic compounds. *Pharm. Acta Helv.* 17:100-109.
1135. Rosenthaler, L. 1948. Detection of organic compounds. *Pharm. Acta Helv.* 23:211-14.
1136. Rosenthaler, L. 1953. Identification of organic compounds. *Pharm. Ztg.-Nachr.* 89:242-244.
1137. Rosenthaler, L., and L. Capuano. 1950. Mohler's reaction. *Mitt. Lebensm. Hyg.* 41:165-167.
1138. Rosenthaler, L. and L. Capuano. 1951. The Mohler reaction. I. The reaction of benzoic acid. *Z. Lebensm.-Untersuch. Forsch.* 92:13-16.
1139. Rosenzweig, S., L. Parteni, and Al. Stancu. 1954. Effect of sodium benzoate on the blood salicylate level. *Problemy Reumatol.* 2:161-165.
1140. Rosin, J. 1923. Caffeine and sodium benzoate. A puzzle unravelled. *Am. J. Pharm.* 95:224-226.
1141. Roskam, R.T. 1962. Preservation of cooked, shelled shrimp. *Neth. Pat.* 102,592, Sept. 17.
1142. Rozental, L., and K. Zakrzewska. 1954. Observations on browning of pre-peeled potatoes. *Roczniki Panstwowego Zakladu Hig.*

1143. Rushing, N. B., and V. J. Senn. 1962. Action of preservatives and storage temperatures on the behavior of cooled citrus fruit salads during storage. *Food Technol.* 16:77-79.
1144. Russu, C., I. Calafeteanu, and A. Jacob. 1958. The application of the refractometric method to a series of magistral mixtures. *Farmacia (Bucharest)* 6:505-510.
1145. Saltschkina, T. Ss. 1954. The antitoxical function of liver in epileptic patients. *Korssakow J. Neuropathol. Psychiatr.* 54:549-550.
1146. Sabalitschka, Th. K. R. Dietrich, and E. Boehm. 1926. Influence of esterization of carbocyclic acids on their development-inhibiting action on microorganisms. *Pharm. Ztg.* 71:834-836.
1147. Sabalitschka, T., K.R. Dietrich, and E. Boehm. 1926. Influence of carbocyclic acid esterification on its development inhibiting action toward microorganisms. *Pharm. Ztg.* 71:834-36.
1148. Sabalitschka, T. and K.R. Dietrich. 1926. Chemical constitution and preservative properties. *Desinfektion* 11:67-71.
1149. Sabalitschka, Th., and H. Marx. 1947. Misconceptions concerning the germicidal and preservative action of sodium benzoate. *Pharm. Ztg.* 83:187-189.
1150. Sadamatsu, A., T. Kina, T. Ariyoshi, and E. Takabatake. 1966. Detection of food preservatives and dulcin by thin-layer chromatography. *Shokuhin Eiseigaku Zasshi* 7(1):50-4.
1151. Sagara, J. 1930. Ornithuric acid synthesis in the hen. *J. Biochem. (Tokyo)* 11(3):427-431.
1152. Sakaguchi, O., M. Yamamoto, and H. Kawauchi. 1958. Bacterial physiology. III. Polysaccharide content and respiration of *Escherichia coli* grown on various nutritive media. *Tohoku Yakka Daigaku Kiyo* 5:9-16.
1153. Sakharova, T.N. 1959. Comparison of certain stabilizers for refrigerated fish filets. *Sbornik Nauch. Rabot. Leningrad. Inst. Sovet. Torgovli Im. F. Engel'sa* 13:97-104.
1154. Saltzman, A., and I. Snapper. 1948. Delay in the formation of hippuric acid from benzoic acid in patients with liver damage. *J. Mt. Sinai Hosp., N.Y.* 15:64-72.
1155. Salvesen, B. 1957. Titration of purine derivatives in nonaqueous medium. I. Potentiometric and visual titration of caffeine. Differential perchloric acid titration of the components of caffeine and sodium salicylate, caffeine and sodium benzoate, and caffeine and diphenhydramine hydrochloride. *Medd. Norsk. Farm. Selskap* 19:199-209.

1156. Sanchez, J., J. Alberola, and I. Garcia. 1964. Detection of citrus juice adulteration. 2. Identification of acids in orange juices. *Rev. Agroquim. Tecnol. Alimentos* 4:371-74.
1157. Sanno, Y., T. Tanaka, S. Hayashi, and M. Suda. 1965. A proposed mechanism for the induction of benzoic acid oxidase in *Micrococcus ureas*. *Biken's J.* 8(1):35-43.
1158. Sanz Sanchez, F., and E. Castella Bertran. 1950. Action of some organic compounds on acid phosphomonoesterase of dog liver. *Anales Facultad Vet. Univ. Madrid y Inst. Invest. Vet.* 2:70-78.
1159. Sasaki, R., and S. Odagiri. 1952. The utilization of enzymes in the intestinal organs of fish. II. The separation of protease from internal organs of fish. *J. Agric. Chem. Soc. Japan* 24(8):352-354.
1160. Sastry, L. V. L., B. S. Bhatia, and G. Lal. 1961. Nonenzymic browning in foods: increased discoloration in some natural and synthetic sulfited systems. *Indian J. Appl. Chem.* 24:35-40.
1161. Sato, T., T. Suzuki, T. Fukuyama, and H. Yoshikawa. 1956. Studies on conjugation of S35-sulfate with phenolic compounds. III. Metabolism of p-cresol, p-hydroxybenzaldehyde and p-hydroxybenzoic acid in rat liver. *J. Biochem. (Tokyo)* 43(4):413-420.
1162. Sato, T., T. Suzuki, T. Fukuyama, and H. Yoshikawa. 1956. Studies on conjugation of S35-sulfate with phenolic compounds. IV. Metabolism of o-cresol, m-cresol, salicylaldehyde, salicylic acid, toluene, benzoic acid and related substances in rat liver. *J. Biochem. (Tokyo)* 43(4):421-429.
1163. Sato, Y. 1954. Influence of various drugs upon the respiratory gaseous metabolism of rats. *Acta Med. Biol. (Japan)* 2:773-785.
1164. Saz, A.K., and F. Bernheim. 1942. The effect of benzoic acid and related compounds on the growth of certain mycobacteria. *J. Bact.* 44(3):385-386.
1165. Scevola, M.E., and M.A. Tisselli. 1960. Effect of several organic acids and bases on catalase activity. *Giorn. Biochim.* 9:171-78.
- * 1166. Schachter, D. 1957. The chemical estimation of acyl glucuronides, and its application to studies on the metabolism of benzoate and salicylate in man. *J. Clin. Invest.* 36:297-302.
1167. Schalaikin, F.P. 1938. Quantitative determination of benzoic acid in fruit and berry products. *Obst. u. Gemuseind. Nr.* 2:37-39.
- * 1168. Schanker, L. S. 1959. Absorption of drugs from the rat colon. *J. Pharmacol. Exptl. Therapeut.* 126:283-290.

- * 1169. Schanker, L. S., P. A. Shore, B. B. Brodie, and C. A. M. Hogben. 1957. Absorption of drugs from the stomach. 1. The rat. *J. Pharmacol. Exp. Therapeut.* 120:528-539.
- * 1170. Schanker, L. S., D. J. Tocco, B. B. Brodie, and C. A. M. Hogben. 1958. Absorption of drugs from the rat small intestine. *J. Pharmacol. Exp. Therapeut.* 123:81-88.
- 1171. Schaposchnikow, W.N., N.A. Koschelewa, I.G. Kolessnikowa, and L.A. Baikowa. 1964. Influence of carbon sources on the biosynthesis of alpha-ketoglutaric acid in *Pseudomonas fluorescens* cultures. *Ber. Akad. Wiss. USSR* 157:180-82.
- 1172. Schildknecht, H., K. Holoubek, and M. Wolkenstoerfer. 1962. A substance contained in the pygidial bladders of the predaceous diving beetle. *Z. Naturforsch.* 17b:81-3.
- 1173. Schildknecht, H., and K.H. Weis. 1962. Repellants of insects. XII. The defense substances of some carabids, in particular of *Abax ater*. *Z. Naturforsch.* 17b:439-47.
- 1174. Schimmel, J., and W.J. Husa. 1956. The effect of different protective substances on microorganisms that were isolated from spoiled syrups. *J. Am. Pharmac. Assoc. Sci. Edit.* 45:204-08.
- 1175. Schirmer, H. and J. Granits-Thurner. 1958. The dependence of fungistatic action on the plasma colloid swelling degree. *Mykosen* 1:141-144.
- 1176. Schlamowitz, M., A. Shaw, and W. Jackson. 1968. The nature of the binding of inhibitors to pepsin and the kinetics of inhibited peptic hydrolysis of N-acetyl-L-phenylalanyl-L-tyrosine. *J. Biol. Chem.* 243(10):2821-8.
- 1177. Schmalfuss, H. 1939. Spoilage of margarine. II. Effect of benzoic acid and of biacetyl. *Fette Seifen* 46:719-22.
- 1178. Schmalfuss, H., and U. Stadie. 1943. Spoilage of margarine. IV. Influence of benzoic acid, biacetyl, and the fat mixture. *Fette Seifen* 50:39239-.
- 1179. Schmidt, C.L.A., and W.E. Scott. 1922. Benzoyltaurin synthesis. *Proc. Soc. Exp. Biol. Med.* 19:403-408.
- 1180. Schmidt, E. W., Jr., and W. A. Gould. 1968. Use of chemical preservatives to inhibit growth of *Staphylococcus aureus* in synthetic cream pies. 28th Ann. Meet. Inst. Food Technol. May 19-24.
- 1181. Schmidt, E. W., Jr., W. A. Gould, H. H. Weiser. 1969. Chemical preservatives to inhibit the growth of *Staphylococcus aureus* in synthetic cream pies acidified to pH 4.5 to 5.0. *Food Technol.* 23(9):1197-1199.

1182. Schmidt, S. 1931. Effect of benzene derivatives on diphtheria toxin. *Compt. Rend. Soc. Biol.* 108:537-9.
1183. Schmidt-Lange, W. 1937. Aerobic and anaerobic bacteria under the influence of benzoic acid. *Arch. Hyg. Bakt.* 118:354-61.
1184. Schmeisser S., I. 1960. Investigation of antiseptics in some foods and beverages. *Anales Fac. Quim. Farm., Univ. Chile* 12:186-93.
1185. Schmeisser S., I., and L. Masson S. 1959. Preservatives in foods and beverages. *Publ. Inst. Invest. Microquim. Univ. Nacl. Litoral (Rosario, Arg.)* 25(23-24):72-80.
1186. Schoenbaum, E., M.K. Birmingham, and M. Saffran. 1956. Metabolism of glucose and steroid formation by rat adrenals in vitro. *Canad. J. Biochem. Physiol.* 34(3):527-533.
1187. Schoenheimer, R., D. Rittenberg, M. Fox, A.S. Keston, and S. Ratner. 1937. Nitrogen isotope (N15) as a tool in the study of the intermediate metabolism of nitrogenous compounds. *J. Am. Chem. Soc.* 59:1768.
1188. Schowalter, E. 1919. Separation of saccharin and benzoic acid. *Ztschr. Unters. Nahrsg.- Genussmittel* 38:185-194.
1189. Schreiber, E.C., B.H. Min, A.V. Zieger, and J.F. Lang. 1968. Metabolism of diethylpropion-1-14C-hydrochloride by the human. *J. Pharmacol. Exp. Ther.* 159(2):372-8.
1190. Schreier, K., K.I. Altman, and L.H. Hempelmann. 1954. Metabolism of benzoic acid in normal and irradiated rats. *Proc. Soc. Exptl. Biol. Med.* 87(1):61-63.
1191. Schwaibold, J. 1932. Detection of benzoic acid and parachlorbenzoic acid in cheese. *Pharmaz. Zentralhalle* 73:513-16.
1192. Schwarz, I.G., O. Fischer, and O. Kahlert. 1935. The detection of preservatives in process cheese. *Milchw. Forsch.* 17:170-80.
1193. Schwerdt. 1930. No benzoic acid for meat products. *Dtsch. Nahrungsmittel-Rdsch.* 68-70.
1194. Scott, R. D., and E. G. Will. 1921. Preservatives for apple wine. *J. Ind. Engin. Chem.* 13:1141-1143.
1195. Scott, T.W., P.F.V. Ward, and R.M.C. Dawson. 1964. The formation and metabolism of phenyl-substituted fatty acids in the ruminant. *Biochem. J.* 90(1):12-24.
1196. Seel, H. 1957. The preservative substances of the benzoic acid chain in the framework of general conditions in the whole sector of nutrition. *Hippokrates (Stuttg.)* 28(7):212-217.
1197. Sekeris, C.E., and P. Herrlich. 1966. Tyrosine metabolism in insects. XVII. The tyrosine metabolism of *Tenebrio molitor* and *Drosophila melanogaster*. *Z. Physiol. Chem.* 344:267-75.

1198. Sen, D. P., K. Visweswariah, and N. L. Lahiry. 1960. Studies on dry-salting and sun-drying of mackerel (*Rastrelliger kanagurtha*). I. Different conditions of drying and their effect on the quality of dry-cured product. *Food Sci.* 10:123-131.
1199. Sen, D. P., K. Visweswariah, and N. L. Lahiry. 1961. Influence of chlortetracyclin, sorbic acid, sodium propionate, sodium benzoate and sodium dihydrogenphosphate on the preservability of sun-dried salted mackerels. *Food Sci. (India)* 10:132-138.
1200. Sen, D. P., and N. L. Lahiry. 1964. Production of higher quality of salt-pickled and sun-dried mackerels. *Food Technol.* 18(1):107-110.
1201. Serger, H. 1930. The preservation of food with benzotron. *Konserven-Ind.* 17:351-352.
1202. Serger, H. 1935. On the question of the so-called toxicity of chemical preservatives. *Chemiker-Ztg.* 59:643-645.
1203. Serger, H., and K. Clarck. 1931. Formic, benzoic and sulfurous acids, their specific actions and the question of their compounds from the standpoint of food preservation. *Chem. Ztg.* 55:838-40.
1204. Serger, H., and G. Luechow. 1934. Detection of fruit for jam manufacture. *Obst. Gemuese-Verwertg.-Ind.* 21:468-70.
1205. Serger, H., and G. Luchow. 1936. Is benzoic acid harmful as a preservative? *Braunschweig. Konserven-Ztg.* 39:5-6.
1206. Serrano Berges, L. 1960. Microtitrations in nonaqueous media. *Inform. Quim. Anal. (Madrid)* 14(2):41-50.
1207. Seydel, J.K., E. Wempe, and H.J. Nestler. 1968. The hypothesis that isoniazid acts via isonicotinic acid. *Arzneim.-Forsch.* 18(3):362-7.
1208. Shalaikin, F.P. 1938. Determination of benzoic acid in fruit and in berry products. *Konservnaya i Plodoovoshchnaya Prom. (U.S.S.R.)* 2:37-9; *Khim. Referat. Zhur.* 1(1):95.
1209. Sharlit, H. 1935. The "membrane method" for determining the fungicidal action of chemicals. Its clinical implications. *Arch. Dermatol. Syphilol.* 31:217-23.
1210. Shaw, P.E., J.H. Tatum, and R.E. Berry. 1968. Base-catalyzed fructose degradation and its relation to nonenzymic browning. *J. Food Chem.* 16(6):979-982.
1211. Shenkin, H. A. 1951. Effects of various drugs upon cerebral circulation and metabolism in man. *J. Applied Physiol.* 3:465-467.
1212. Sherman, H.C., and N.M. Naylor. 1922. Influence of several organic compounds on starch hydrolysis by saliva and pancrease amylase. *J. Am. Chem. Soc.* 44:2957-66.

1213. Shiflett, M. A., J. S. Lee, and R. O. Sinnhuber. 1967. Effects of food additives and irradiation on survival of salmonella in oysters. *Appl. Microbiology* 15(3):476-479.
1214. Shinn, C.T., B.J. Sciarrone, and C.A. Discher. 1970. Effect of certain additives on the photochemistry of riboflavin. *J. Pharm. Sci.* 59(3):297-302.
1215. Shiple, G. J., and C. P. Sherwin. 1922. Synthesis of amino acids in animal organisms. I. Synthesis of glycocol and glutamine in the human organism. *J. Am. Chem. Soc.* 44:618-624.
1216. Shitomi, I. 1953. A different type adaptation of *Mycobacterium tuberculosis avium*. *Kekkaku (Tuberculosis)* 28:342-7.
1217. Shpan'ya, P. 1959. The determination of organic substances present in small amounts in foods. 1959. *Konserv. i. Ovoshchesushil. Prom.* 14(7):32-34.
- * 1218. Shtenberg, A. J., and A. D. Ignat'ev. 1970. Toxicological evaluation of some combinations of food preservatives. *Food Cosmet. Toxicol.* 8(4):369-380.
1219. Shumilova, M. N. 1968. Effect of sodium benzoate on the quality of spicily pickled anchovies and sardelles. *Ryb. Khoz.* 44(9):60-62.
1220. Shupe, I.S. 1938. Report on microchemical tests for the identification of synthetics. *J. Assoc. Official Agr. Chem.* 21:528-9.
1221. Sierra de la Fuente, J. 1951. Analytical study of food preservatives. *Fac. Quim. y Farm., Tesis Quim. Farm.* 3:94-114.
1222. Sigrido, B. 1963. Gas chromatography as a tool for the simultaneous detection of some chemical preservatives in foods. *Ind. Conserve (Parma)* 38(2):125-6.
1223. Silbereisen, K., and B. Wagner. 1970a. The use of chemical preservative for beer stabilization-a review. *Monatssch. Brauerei* 23(2):32-36.
1224. Silbereisen, K., and B. Wagner. 1970b. Gas chromatographic determination of chemical preservatives in beer. *Monatssch. Brauerei* 23(3):57-77.
1225. Silver, R.E. 1945. How to retard rancidity in salt-cured fish. *Food Industries* 17:1454-6, 1596, 1598, 1600.
1226. Simkin, J.L., and K. White. 1957a. The formation of hippuric acid. The influence of benzoate administration on tissue glycine levels. *Biochem. J.* 65(3):574-581.
- * 1227. Simkin, J. L., and K. White. 1957b. The formation of glycine and serine. The influence of the administration of glycine, DL-serine and other compounds on levels of tissue glycine and serine. *Biochem. J.* 67(2):287-291.

1228. Simon, I., and P. Chiaverini. 1953. Action of caffeine on the isolated frog heart. *Boll. Soc. Ital. Biol. Sper.* 29:310-311.
1229. Simonart, P., and J. Mayaudon. 1956. Chromatographic study of cheese. 3. Aromatic acids. *Nederl. Melk. Zuiveltijdschr.* 10:261-67.
1230. Sinell, H.J., and J. Baumgart. 1966. The effect of sorbic acid and benzoic acid on the microflora in mayonnaises and salads. Presented at the 2nd International Congress of Food Science and Technology, Warszawa, Poland, Aug. 22-27.
1231. Singer, S., and M. Mason. 1965. Tyrosine-alpha-ketoglutarate transaminase. Effect of the administration of sodium benzoate and related compounds on the hepatic enzyme level. *Biochim. Biophys. Acta* 110(2):370-379.
- * 1232. Singer, S., and M. Mason. 1967a. The effects of the administration of sodium benzoate and diethylstilbestrol disulfate on the hepatic levels of several glucocorticoid-sensitive enzymes in adrenalectomized rats. *Biochim. Biophys. Acta* 146(2):443-451.
1233. Singer, S., and M. Mason. 1967b. In vitro and in vivo effects of conjugated steroids and carboxylic acids on hepatic tyrosine transaminase in the rat. *Biochim. Biophys. Acta* 146(2):452-66.
1234. Singh, L., and G. Lal. 1938. A study on the preservation of fruit juices. I. Some observations on the preparation and preservation of citrus fruit pulp. *Indian J. Agr. Sci.* 8:77-102.
1235. Sinha, S.N., and E.R. Gabrieli. 1968. A simple method for simultaneous determination of benzoic and hippuric acid in biological fluids. *Clin. Chim. Acta* 19(2):313-317.
1236. Sirasaka, T. 1941. The influence of various pharmaceutical agents on the bleeding time and amount of bleeding. II. The action of some cardiotonic agents. *Okayama Igakkai Zasshi* 53:193-204.
1237. Sleeper, B.P. 1951. The bacterial oxidation of aromatic compounds. V. Metabolism of benzoic acids labeled with C14. *J. Bact.* 62(5):657-662.
1238. Sloane, N.H. 1965. Hydroxymethylation of the benzene ring. 1. Microsomal formation of phenol over previous hydroxymethylation of benzene. *Biochim. Biophysica Acta (Amsterdam)* 107:599-602.
1239. Slooten, J. van. 1930. Report of a research into the problem of whether or not it is desirable to allow salicylic acid or any other preservative to be added in the preparation of lemonades. *Mededeel. Dienst Volksgezondheid Nederlandsch-Indie* 19(3):547-580.

1240. Smith, E. E. 1927. Sodium benzoate permitted in food products and beverages. A resume of federal and state laws. Useful information for every concern using this preservative. *Fruit Prod. J.* and *Amr. Vinegar Ind.* 6(8):19.
1241. Smith, E. S., J. F. Bowen, and D. R. MacGregor. 1962. Yeast growth as affected by sodium benzoate, potassium sorbate, and vitamin K5. *Food Technol.* 16(3):93-95.
1242. Smith, F.G., J.C. Walker, and W.J. Hooker. 1946. Effect of hydrogen-ion concentration on the toxicity to *Colletotrichum circinans* (Berk.) Vogl. of some carboxylic acids, phenols, and crucifer extracts. *Am. J. Bot.* 33(5):351-356.
1243. Smith, J. N. 1958. Comparative detoxification. 5. Aromatic acid conjugation in reptiles: formation of ornithuric acid, hippuric acid and glucuronides. *Biochem. J.* 69:509-516.
1244. Smith, M.J.H., B.J. Gould, and A.K. Huggins. 1963. Inhibition of glutamate decarboxylase by salicylate-similar compounds. *Biochem. Pharmacol.* 12:917-18.
1245. Smith, M. J. H. 1952. Monohydroxybenzoic acids and ascorbic acid depletion of the adrenal glands of the intact rat. *Lancet* 262:991-993.
1246. Smith, M. J. H. 1958. Action of salicylate on metabolism of acetate -2-C14 in the rat. *Science* 128:423.
1247. Smith, M. J. H. 1959. Salicylates and metabolism. *J. Pharm. and Pharmacol.* 11:705.
1248. Smouse, T.H., and S.S. Chang. 1967. A systematic characterization of the reversion flavor of soybean oil. *J. Am. Oil Chem. Soc.* 44(8):509-14.
- * 1249. Smyth, H. F., Jr., and C. P. Carpenter. 1948. Further experience with the range-finding test in the industrial toxicology laboratory. *J. Ind. Hyg. Toxicol.* 30(1):63-68.
1250. Snapper, I. 1924. Hippuric acid metabolism in man. *Klin Wchschr.* 3:55-56.
1251. Snapper, I., W. M. Bendien, and A. Polak. 1936. The formation and the prevention of calculi. *Brit. J. Urol.* 8:337-345.
1252. Snapper, I., E. Greenspan, and A. Saltzman. 1946. Differences in excretion of hippuric acid and glucuronates after ingestion of sodium benzoate and benzoic acid. *Am. J. Digest. Dis.* 13(9):275-279.
1252. Snapper, I., and A. Gruenbaum. 1922. Is retardation of hippuric acid excretion in kidney degeneration diseases caused by a retarded synthesis of hippuric acid in the kidney. *Nederl. Tijdschr. Geneeskunde* 66(11):2910-2916.

1253. Snapper, I. and A. Gruenbaum. 1926. Excretion of hippuric acid by diseased kidneys. *Presse Med.* 34:1524-26.
1254. Snapper, I., and A. Gruenbaum. 1934. Synthetic and oxidative functions of the kidney. *Acta Brevia Neerland. Physiol. Pharmacol. Microbiol.* 4:38-42.
1255. Snapper, I., A. Gruenbaum, and J. Neuberg. 1923. The significance of the kidney for the synthesis of hippuric acid in man, dog, pig and sheep. *Nederl. Tijdschr. Geneeskunde* 67:426-33.
1256. Snapper, I., A. Gruenbaum, and J. Neuberg. 1924. Hippuric acid synthesis in surviving kidneys from different animal genuses, also from man. *Biochem. Ztschr* 145:40-46.
1257. Snapper, I., and A. Saltzman. 1947a. Quantitative aspects of benzoyl glucuronate formation in normal individuals and in patients with liver disorders. *Am. J. Med.* 2:327-333.
1258. Snapper, I., and A. Saltzman. 1947b. Excretion of glucuronate as a test of liver function. *Am. J. Med.* 2:334-341.
1259. Snapper, I. and A. Saltzman. 1948. Excretion of glucuronates after ingestion of benzoic acid or cinnamic acid as a test of liver function. *Conf. on Liver Injury, Trans. 7th Conf.* 1948, 77-85.
1260. Snapper, I., A. Saltzman, and E. Greenspan. 1946. Increased excretion of glucuronate after ingestion of benzoic acid by patients with damaged liver. *Am. J. Digestive Diseases* 13:341-4.
1261. Snethlage, H.C.S. 1929. Determination of salicylic acid and benzoic acid in foodstuffs. *Chem. Weekblad* 26:604-5.
1262. Snethlage, H.C.S. 1936. The oxidimetric analysis of binary mixtures of organic compounds. *Rec. Trav. Chim.* 55:58-60.
1263. Soler, A., F.S. Garcia, and J.A. Lozano. 1965. Structural inhibitors of apricot phenolase. *Rev. Espan. Fisiol.* 21(4):139-44.
1264. Sollmann, T. 1947. Effects of various chemicals on survival of frog muscle and nerve after somatic death. *J. Pharmacol.* 90:14-25.
1265. Sollmann, T., J. J. Estable. 1948. Action of procaine, salicylate, and benzoate of sodium on the excitability of skeletal muscle and and of nerve. *Anesthesiology* 9:188-194.
1266. Sol'ts, L. M. 1940. Determination of caffeine-sodium salicylate. *Konsultatsionnye Materialy* 2:65.
1267. Sorman, L. 1961. Determination of the effectiveness of pectolytic enzymes with a synthetic substrate. *Chem. Zvesti* 15:370-376.

1268. Soroka, V. R. 1960. Effect of stimulation and inhibition of the central nervous system on the content of copper in the brain tissue and in the blood. *Ukrain. Biokhim. Zhur.* 32:718-723.
1269. Soroka, V. R. 1966. Forms of residence of certain trace elements in the brain in different functional states of the central nervous system. *Mater. Vses. Simp. Mikroelem. Nerv. Sist.* 125-129.
1270. Soroka, V. R. 1967. States of some trace elements in the liver during changes in the central nervous system function. *Ukr. Biokhim. Zh.* 39(3):248-251.
1271. Soto, M. 1929. Pharmacology of cholagogues. *Rev. Soc. Argent. Biol.* 5(5-6):286-306.
1272. Sowbhagya, C.M., K. Mayura, K.G. Nair, L.V.L. Sastry, and G.S. Siddappa. 1963. Estimation of benzoic acid in the presence of vanillin in synthetic sirups. *J. Assoc. Offic. Agr. Chem.* 46(4):767-768.
1273. Spangler, R.A., and F.M. Snell. 1967. Transfer function analysis of an oscillatory model chemical system. *J. Theor. Biol.* 16(3):381-405.
1274. Spanyar, P. 1958. Determination of preservatives in food. *Lebensmittel Analyt. Mitt.* 4:213-21.
1275. Spanyar, P. 1959. Content determination of organic substances that are found in foods in insignificant amounts. *Konserv. Obo. Prom.* 14(7):32-34.
1276. Spanyar, P., E. Kevei, and M. Kiszal. 1958. A new simple process for determination of benzoic acid in foods. *Z. Lebensm.-Untersuch. Forsch.* 107:118-124.
- * 1277. Spaulding, E. H., A. Bondi, Jr., and E. Early. 1947. The effect of combining sodium benzoate with oral penicillins. *Science* 105(2721):210-211.
1278. Spooner, C. E., and W. D. Winters. 1966. Neuropharmacological profile of the young chick. *Intern. J. Neuropharmacol.* 5(3):217-236.
- * 1279. Sporn, A. B., Zh. M. Peretsianu, and Zh. S. Gal'perin. 1958. Studies of the toxicity of chemicals added to food. *Voprosy Pitaniya* 17(4):48-53.
1280. Sproull, D. H. 1961. Salicylate and liver glutathione. *Brit. J. Pharmacol. Chemoth.* 16:180-187.
1281. Spurgeon, K. R., S. W. Seas, J. O. Young. 1970. Develop low-fat dairy spread. *Am. Dairy Rev.* 32(9):48, 50.

1282. Stachiewicz, E., and J. H. Quastel. 1959. Effects of dihydrostreptomycin on amino acid incorporation into the proteins of (*Mycobacterium*) tuberculosis (BCG). *Canadian J. Biochem. Physiol.* 37(5):687-697.
1283. Stadler, R. and G. Juhasz. 1954. Manufacture of skins, especially artificial sausage skins made of paper. *Austrian Pat.* 178 533.
1284. Stahl, E. 1969. TAS-method for rapid separation of pesticides and preservatives. *Z. Lebensm.-Unters. -Forsch.* 140(6):321-329.
1285. Stamm, H. 1969. Nuclear magnetic resonance studies of the association of caffeine with sodium benzoate and some other compounds. *Arch. Pharm. (Weinheim)* 302(3):174-184.
1286. Stanier, R.Y., I.C. Gunsalus, and C.F. Gunsalus. 1953. The enzymatic conversion of mandelic acid to benzoic acid. II. Properties of the particulate fractions. *J. Bact.* 66(5):543-547.
1287. Stanley, R.L. 1959. Determination of benzoic acid in foods. *J. Assoc. Offic. Agr. Chemists* 42:486.
1288. Stanley, R.L. 1960. Benzoic acid in foods. *J. Assoc. Offic. Agr. Chemists* 43:587-91.
1289. Stanley, R.L. 1963. Rapid screening procedure for benzoates in meat. *J. Offic. Agr. Chem.* 46(4):616-618.
1290. Stark, E. 1959. Quantitative determination and studies of the excretion of free benzoic acid, in man and animal, under normal and pathological conditions. *Acta Med. Acad. Sci. Hungaricae* 13(1/4):267-275.
1291. Stark, E., K. Lempert, and K. Vagi. 1957. Isolation of free benzoic acid from the urine of Cushing disease patients. *Naturwissenschaften* 44:539-40.
1292. Stark, E., K. Lempert, and K. Vagi. 1958. Isolation of benzoic acid from the urine of patients suffering from hyperfunction of the hypophysis-adrenal cortex system. *Magyar Tudomanyos Akad. Biol. Orvosi Tudomanyok Osztalyanak Kozlemenyei* 8:415-16.
1293. Stas, M.E. 1957. Detection and determination of boric and benzoic acids in egg products. *Chem. Weekblad* 53:536-8.
1294. Stassi, M. 1933. Benzoic acid intoxication. I. (with) sodium glycolate II. (with) ammonium glycolage. III. (with) sodium citrate. *Boll. Soc. Ital. Biol. Sper.* 8:1224-1229.
1295. Stassi, M. 1934. Benzoic acid intoxication. IV. Benzoic acid and sodium carbonate. *Boll. Soc. Ital. Biol. Sper.* 9:352-3.

- * 1296. Stecher, P.G., M. Windholz, D.S. Leahy, eds. 1968. The Merck Index: an encyclopedia of chemicals and drugs, 8th edit. Merck and Co., Inc. Rahway, N.J. pp. 132-133.
- 1297. Steenhauer, A.J. 1935. The micro copper-pyridine test for some organic acids. Pharm. Weekblad 72:667-9.
- 1298. Steggle, R.A., A.K. Huggins, and M.J. Smith. 1961. Inhibition of rat serum glutamic-pyruvic transaminase in vitro by congeners of salicylate. Biochem. Pharmacol. 7:151-3.
- * 1299. Stein, W. H., A. C. Paladini, C. H. W. Hirs, and S. Moore. 1954. The enylacetylglutamine as a constituent of normal human urine. J. Am. Chem. Soc. 76:2848.
- 1300. Steinmetzer, K. 1926. Experimental investigation of cholagoges. Wiener Klin. Wochschr. 39:1418-1422.
- 1301. Stekol, J.A. 1947. Studies on the mercapturic acid synthesis in animals. XV. On the mechanism of inhibition of growth of rats by benzyl chloride. J. Biol. Chem. 167(3):637-643.
- 1302. Stepanowa, O. Ss., and E. N. Alter. 1959. Influence of additives on the preservation of a stomach juice and on the retention of its properties. Pharmaz. J. (Kiev) 14(6):41-45.
- 1303. Stevens, J. W., and D. E. Pritchett. 1956. Stabilization of citrus-juice products. U. S. Pat. 2,764,486, Sept. 25.
- 1304. Stibic, J. 1968. Absorption apparatus to measure losses of dry matter in sugar beet silage preserved with sodium benzoate. Arch. Tierernaehr. 18(3):239-243.
- 1305. Storey, I.D.E. 1964. Differences in the behavior of uridindiphosphate-transglucuronylase of the mouse liver towards o-aminophenol and p-nitrophenol. Biochem. J. 90(1), Proc. Biochem. Soc. 16P.
- 1306. Storey, I.D.E. 1965. Some differences in the conjugation of o-aminophenol and p-nitrophenol by the uridine diphosphate transglucuronylase of mouse-liver homogenates. Biochem. J. 95(1):209-14.
- 1307. Strohmeyer, G. and V. Klingmueller. 1964. Coupling products made of glutamic acid, glutamine, asparagin and aromatic carboxylic acid. Clin. Chim. Acta (Amsterdam) 9:285-91.
- 1308. Struwe, F. E. 1956. Benzoic acid detoxication in schizophrenia. Nervenarzt 27:25-8.
- 1309. Subramanyam, H., and P. B. Mathur. 1956. Influence of fungicide growth coating on storage behavior of tapioca roots. Bull. Centr. Food Technol. Res. Inst., Mysore 5:110-111.

1310. Sulc, D. 1961. Contemporary manufacture of (fruit) juices. *Tehnika* (Belgrade) 16:1484-9.
1311. Sugiyama, S., and T. Furukawa. 1929. A new plethysmograph and the actions of various drugs examined with it. *Acta Schol. Med. Univ. Imp.-Kioto* 11:591-597.
1312. Sugiyama, N., R. Harada, T. Mita, and T. Ueno. 1951. Reagents for the identification of organic acids. Colored derivatives of carboxylic acids. *J. Chem. Soc. Japan, Pure Chem. Sect.*, 72:152-4.
1313. Supniewski, J. 1924. Cyclic compound metabolism in *Bacillus pyocyaneus*. *Biochem. Ztschr.* 146:522-35.
1314. Sutton, R.W., and O. Hitchen. 1940. Determination of benzoic acid. *Analyst* 65:502.
1315. Suzuki, A., H. Kurusu, S. Ai, T. Ohashi, and T. Serizawa. 1967. Studies on the preservation of juice-type carbonated beverages. *Sokuhim Eiseigaku Zasshi* 9(2):91-96.
1316. Suzuki, M., T. Tomimura, and H. Mizutani. 1955. Interrelation between the function of heme-proteins and the structural modifications of their protein parts. IV. Effect on some protein perturbators upon the catalytic function of catalase. *J. Biochem. (Tokyo)* 42(2):99-109.
1317. Suzuki, T. 1953. The influence of various chemical preparations on the oxygen consumption of *Mycobacterium tuberculosis*. *Sci. Rep. Res. Inst. Tohoku Univ., Ser. C* 5:27-34.
1318. Svetlov, I.P. 1932. Food preservatives. *Izvestiya Tzentral. Nauch.-Isseledovatel. Inst. Pishchevoi Vkusovoi Prom.* No. 6, 20 pp.
- * 1319. Swanson, W. W. 1925. The effect of sodium benzoate ingestion upon the composition of the blood and urine with special reference to the possible synthesis of glycine in the body. *J. Biol. Chem.* 62:565-573.
1320. Swartz, J.H., and T.F. Medrek. 1968. Antifungal properties of cranberry juice. *Appl. Microbiol.* 16(10):1524-1527.
1321. Sykes, G. 1958. The basis for "sufficient of a suitable bacteriostatic" in injections. *J. Pharm. Pharmacol.* 10(Suppl):40T-46T.
1322. Taeufel, K., F. Linow, and H. Ruttloff. 1963. Benzoyl citric acid and benzoic acid as fungistatica. *Nahrung* 7:502-507.
1323. Taha El-Katib, M. M. 1954. Relation to stage of lactation to volatile and unsaturated fatty acids of egyptian cow and buffalo butter-fat. *Indian J. Dairy Sci.* 7(2):101-109.
1324. Tajima, T. 1955. Sarcosine oxidase. *Fukuoka Acta Med.* 46:717-24.
1325. Takagi, S. 1925. The localized anesthetic action of various drugs. I. *Folia Japon. Pharmacol.* 1:324-40.

1326. Takahashi, M. 1928. The detoxification process in fetal organisms. I and II. Hoppe-Seyler's Zeitschr. Physiol. Chem. 178(4/6):291-297.
1327. Takahashi, M. 1929. Destiny of hippuric acid in the chick's organism. J. Biochem. 10:457-61.
1328. Takashima, T. 1956. Biophysical studies on the glutamic dehydrogenase system. V. Interaction of active centers of enzyme protein with low-molecular compounds. Osaka Daigaku Igaku Zasshi 8:1-6.
1329. Takeda, R., H. Ikebe, and Y. Yamamoto. 1962. Antimicrobial activity of sodium benzoate in soy sauce. I. Kagawa-ken Hakko Shokuhin Shikenjo Hokoku 54:25-32.
1330. Takeda, Y. and Y. Aoki. 1957. Studies on the resistance of M. tuberculosis to the hydrazino-derivatives. Japanese J. Tuberc. 5(1/2):11-24.
1331. Takei, S., and T. Imaki. 1936. Odiferous substances of raw sugar. I. Volatile organic acids on cane molasses. Bull. Inst. Physic. Chem. (Abstr.) Tokyo 15:6-7.
1332. Takemura, H., S. Yamamoto, H. Ishihara, and O. Ishizaka. 1969. Toxicity test of food additives by the disturbance of life cycle of Chlorella: IV. Influence of food preservatives on the in-take of amino acids by Chlorella. J. Food Hyg. Soc. Jap. 10(5):328-333.
1333. Takemura, Y., T. Yamada, K. Ozawa, and K. Shichijo. 1966. Comparison of the effects of several drugs on tissue uptake of labeled thyroxine and triiodothyronine in the presence of rat plasma in vitro. Metab., Clin. Exptl. 15(8):679-686.
1334. Takeshita, R., and Y. Sakagami. 1967. Studies on food additives (Food preservatives, artificial sweeteners, etc.) (X) Detection of food preservatives in goods. Shokuhin Eiseigaku Zasshi 8(2):131-134.
1335. Takeuchi, T., T. Amano, and H. Yoshii. 1963. Studies on the shoyu antiseptics III. On the antifungal actions of sodium benzoate in tamari and white soy sauce. J. Fermentation Technol. 41(9):480-487.
1336. Tamiya, H., T. Yanagita, and Y. Suzuki. 1947. New classification of antibacterial substances according to their modes of action. J. Penicillin (Japan) 1:264-70.
1337. Tanaka, N., G. Hirata, and I. Utsumi. 1969. Interaction of drugs with polymers: IV. The swelling of crosslinked polyacrylic acid in salt solutions. Yakugaku Zasshi 89(11):1576-1580.
1338. Tanaka, S., and H. Kawakita. 1951. Antiseptics. III. The effect of the antiseptics against putrefaction microorganisms. J. Fermentation Technol. (Japan) 29:389-393.

1339. Tanikawa, E., M. Akiba, and T. Motohiro. 1964. The complete utilization of squid (*Ommastrephes sloani pacificus*) XXI. Manufacture of smoked squid meat. 3. Hokkaido Daigaku Suisan Gakubu Kenkyu Iho 15:47-57.
1340. Tanner, F. W., and L. B. Staruch. 1926. Effect of sodium benzoate upon certain yeasts. Proc. Soc. Exper. Biol. Med. 23:449-450.
1341. Tao, C.C., and T.H. Elliott. 1962. Metabolism of 14C-methylcyclohexan. Biochem. J. 84, 38P.
1342. Tarantola, C. 1955. Aspecific biological methods for detecting antifermentative substances in musts and wines. Riv. Viticolt E. Enol (Conegliano) 8:189-98.
1343. Tarr, H.L.A. 1939. Effectiveness of benzoic acid ice for fish preservation. Evidence from bacteria and trimethylamine. J. Fisheries Res. Board Can. 4:327-34.
1344. Tarr, H. L. A. 1940. Use of chemicals and ultraviolet light in preserving fish. Proc. 1st Food Conf. Inst. Food Tech. 1:145-148.
1345. Tarr, H.L.A., and P.A. Sunderland. 1939. Role of preservatives in enhancing the keeping quality of fresh fillets. Fisheries Research Board Can., Progress Repts. Pacific Stas. 39:13-16.
1346. Tarr, H. L. A. 1946. Germicidal ices. Fisheries Res. Bd. Can., Progress Repts., Pacific Coast Stas. 67:36-40.
1347. Tatum, J.H., P.E. Shaw, and R.E. Berry. 1967. Some compounds formed during nonenzymic browning of orange powder. J. Agr. Food Chem. 15(5):773-775.
1348. Taxner, K. 1939. Standardization of qualitative rules for fruit juices. Congr. Intern. Tech. Chim. Ind. Agr. Compt. Rend. Vle Congr., Budapest 1:527-534.
1349. Taylor, J.K., and S.W. Smity. 1959. Precise coulometric titration of acids and bases. J. Res. Natl. Bur. Standards 63A:153-9.
1350. Taylor, W. J. R., C. R. Woolf. 1967. Comparative evaluation of nikethamide, prethcamide, and caffeine as respiratory stimulants in patients with chronic chest disease, mostly emphysema. Int. Z. Klin. Pharmakol. Ther. Toxikol. 2:92-100.
1351. Teisinger, J., and J. Srbova. 1955. Benzoates, elimination of benzoic acid in urine and its relation to maximum tolerable concentration of toluene in air. Arch. Mal. Profess. 16:216-220.
1352. Terasaki, M. 1959. Pharmacological contribution to mesenteric circulation in comparison with cerebral circulation. Nippon Yakurigaku Zasshi 55:78-91.
1353. Terni, M., A. Lamanna, and F. Pasquinelli. 1952. Influence of sodium salicylate and sodium benzoate on oxygen use of a PAS-resistant and virulent strain of *Mycrobacterium tuberculosis hominis*. Sperimentale 102:293-297.

1354. Terroine, E.F., R. Bonnet, P. Danmanville, and G. Mourof. 1930. The excretion of creatinic bodies a function of the amount of the endogenous nitrogen discharged. *Compt. Rend.* 191:1473-5.
1355. Terroine, E.F., R. Bonnet, P. Danmanville, and M.G. Mourof. 1932. The physiology of creatinine and creatine. I. The excretion of creatinine and creatine in minimum nitrogen expenditure and inanition. *Bull. Soc. Chim. Biol.* 14:12-46.
1356. Terroine, E.F. and G. Boy. 1939. Nitrogen metabolism. II. Benzoic acid. *Arch. Intern. Pharmacodynamie* 63:300-25.
1357. Terroine, E.F., and G. Boy. 1941. Does benzoic acid poisoning decrease creatinuria induced by thyroxine? *Trav. Membres Soc. Chim. Biol.* 23:1086-93.
1358. Terui, G., and I. Shibazaki. 1949. Citrinin and related metabolic products. III. Antibiotic substances with multiplying effect upon the bacteriostatic activity of citrinin. *J. Fermentation Technol. (Japan)* 27:150-6.
1359. Terui, G., and T. Enatsu. 1956. Benzoic acid metabolism in *Aspergillus niger*. *Technol. Rep. Osaka Univ.* 6:203-17.
1360. Teschemacher, H. J., A. Herz, R. Hess, and G. Novoczek. 1968. Permeation of purine derivatives into the cerebrospinal fluid of dogs. *Experientia* 24(1):54-55.
1361. Testa, J. 1932. Determination of benzoic acid in Argentine wines. *Requind* 1:21.
1362. Thome, K.E. 1939. Effect of some preservatives on yeasts and molds from cheese. *Medd. Statens Mejeriforsok*, No. 3, 20 pp; *Dairy Sci. Abstracts* 2:140.
1363. Thomsen, A. 1937. Glycocol formation in patients with muscular dystrophy. *J. Clin. Invest.* 16:231-236.
1364. Thomson, A. G. 1954. The prevention of mold formation on meat. *Food* 23:57-58.
1365. Tiba, S. 1940. Influence of aromatic compounds upon reduced glutathione in organs. *Zikken Syokakibyogaku (Exptl. Gastroenterol.)* 15:347-360.
1366. Tilgner, D.J. and R. Schillak. 1937. Preservatives, particularly oxybenzoic acid ester. *Przemyst Chem.* 21:329-46.
1367. Tjaden. 1930. The use of benzoic acid in chopped meat. *Arch. Hyg.* 104:184-96.
1368. Tjaden. 1933. Keeping chopped meat fresh with benzoic acid. *Z. Fleisch. Milchhyg.* 43:183-87.

1369. Todani, T., N. Okada, and S. Maeshige. 1966. Effects of food preservatives on foods boiled down in soy sauce. I. Influence of food constituents on the effectiveness of food preservatives. *Nippon Shokuhin Kogyo Gakkaishi* 13(4):125-130.
1370. Tomimura, T., M. Suzuki, and H. Mizutani. 1954. Effect of inhibitors on the catalytic activity of catalase. *Symposia on Enzyme Chem. (Japan)* 9:98-99.
1371. Torda, C., and H.G. Wolff. 1946. Effect of some isocyclic, aromatic, and heterocyclic compounds on muscle sensitivity to acetylcholine and potassium. *Am. J. Physiol.* 145:608-14.
1372. Totter, J. R., E. S. Amos, and C. K. Keith. 1949. The influence of pteroylglutamic acid on glycine and on porphyrin metabolism. *J. Biol. Chem.* 178(2):847-854.
1373. Treadwell, W.D., and E. Wettstein. 1935. Formation of complexes of ferric ion with carboxylic acids. *Helv. Chim. Acta* 18:200-10.
1374. Treadwell, W.D. and E. Wettstein. 1935. Titration of organic acids with ferric chloride. *Helv. Chim. Acta* 18:981-6.
1375. Trifiro, E. 1960. The detection of sublimable preservatives. *Ind. Conserve (Parma)* 279-86.
1376. Trolle-Lassen, C. 1958: Fungistatic activity of sorbic acid and other preservatives. *Arch. Pharm. Chemi* 65:679-85.
1377. Tronzo, R.J., C. Cervello, and A. Aranda. 1969. Simultaneous presence of several preservative agents in citrus juices and drinks. *Revista de Agroquimica y Tecnologia de Alimentos* 9(2):292-95.
1378. Tsiperovich, A. S., and A. L. Loseva. 1955. The mechanism of protein denaturation. VI. The denaturation of spherical proteins without changes in viscosity or optical rotation. *Ukrain. Biokhim. Zhur.* 27:494-501.
1379. Tsukamoto, H. 1951. Fungicides for soy sauce. I. Fungicidal action of ethyl thiocynoacetate. *J. Pharm. Soc. Japan* 71:400-2.
1380. Tsukamoto, A. 1960. Oxidation of o-phthalate and related substances by baker's yeast. *J. Biochem. (Tokyo)* 47:559.
1381. Tsukamoto, H., O. Kamata, and K. Yatsuki. 1964. The effect of glucuronide-forming drugs on beta-glucuronidase activities in various organs. *Seikagaku* 36(12):873-8.
1382. Tsushima, K. 1954a. Interaction between the catalytic function of hemeproteins and the structural modifications of their protein parts. I. Spectroscopical observations made on the reaction between hemoglobin and benzoate. *J. Biochem. (Tokyo)* 41(2):215-226.

- * 1383. Tsushima, K. 1954b. Interrelation between the function of heme proteins and the structural modification of their protein parts. II. Effect of benzoate upon the autoxidation of oxyhemoglobin. J. Biochem. (Japan) 41(3):359-366.
- 1384. Tsuzi, K. 1956. Convulsion caused by phenol compounds. Kumamoto Med. J. 9:152-64.
- 1385. Tulane, V. J., et al. 1933. Studies in the synthesis of hippuric acid in the animal organism. VIII. Hydrazine intoxication and hippuric acid synthesis in the rabbit, by Victor, J. Tulane, A. A. Christman, and Howard B. Lewis; IX. A comparative study of the rate of synthesis and excretion of hippuric and phenaceturic acids by the rabbit, by Victor J. Tulane and Howard B. Lewis. J. Biol. Chem. 103(1):141-150, 151-160.
- 1386. Tyler, A. 1954. Chemical agents and poisonous metals in food and water. Roy. Sanit. Inst. J. 74:985-92.
- 1387. Tyuma, I. 1957. Mode of association of amino acid oxidase system. Nara Igaku Zasshi 8:285-9.
- 1388. Ueda, S.-I. 1967. Uropepsin values in various digestive diseases. Sumitomo Bull. Ind. Health 3:163-172.
- 1389. Union of Soviet Socialist Republics, Komitet Standartov. 1969. Jam. Rus. Pat. 6442-69, 12 pp.
- 1390. Union of Soviet Socialist Republics, Komitet Standartov, Mer i Izmeritel'nykh Priborov. 1970. Preserved gutted fish: quality requirements for attested products. Soviet Standard GOST 5.530-70 6pp.
- 1391. Valerio, A. 1936. Chronic suppuration treated with intravenous sodium benzoate. J. Clinicos 17:7; Rev. Sud-americana Endocrinol., Immunol. Quimioterap. 20:160.
- 1392. Van Cauwenberge, H. 1951. The effect of salicylates on hypophyse and the adrenals. Lancet 261:686-687.
- 1393. Van Cauwenberge, H. 1953. Reaction of the hypothalamic-hypophyseal-adrenal axis to some benzene derivatives. Compt. Rend. Soc. Biol. 147:1118-1121.
- 1394. Van Dame, H.C. 1960. Chromatographic separation and ultraviolet determination of benzoic acid m-hydroxybenzoic acid, p-hydroxybenzoic acid, and salicylic acid in mixtures. J. Assoc. Offic. Agr. Chemists 43:593-4.
- 1395. Van de Beek, M. J., S. Y. Gerlsma. 1969. Preservation of the enzymic activity of rennin during spray drying and during storage, and the effect of sugars and certain other additives. Ned. Melk-Zuiveltijdschr. 23(1):46-54.

1396. Vandercook, C. E., and H. C. Guerrero. 1968. Fruits and fruit products. Effects of chemical preservatives and storage on constituents used to characterize lemon juice. J. Ass. Offic. Anal. Chem. 51(1):6-10.
1397. Van Itallie, E.I. 1920. Determination of benzoic acid in fats. Pharm. Weekblad 67:688-91.
1398. Van Itallie, E.I. 1921. The labeling of foods artificially preserved. Pharm. Weekblad 58:1369-90.
1399. Van Sluis, K.J.H. 1957. Benzoic acid. Chem. Prod. 20:141-2.
1400. Van Wieren, W. H., and J. C. Langberg. 1966. Making soft unripened curd cheeses. U. S. Pat. 3,232,768 (Cl. 99-162), Feb. 1, 1966, Appl. May 5, 1961; 2pp.
1401. Van Zijp, C. 1930. Microchemical contributions. Pharm. Weekblad 67:189-98.
1402. Varga, M. 1957. Testing growth inhibitors in pulpy fruits that were separated by paper chromatography. 3. Concentration changes of growth inhibitors depending on the ripening process. Acta Biol. (N.S.) 3:225-232.
1403. Varga, M., and E. Koves. 1959. Cyclic carboxyl acids as growth and germination inhibitors in dried fruits. Nature (London) 183:401.
1404. Vas, K. 1954. Kinetic examination of factors affecting growth of microbial populations. Agrokemia es Talajtan 3:205-26.
1405. Vasiliu, H., A. Timosencu, C. Zaimov, and V. Coteleu. 1940. The nitrogen-free parent substances of hippuric acid. The behavior of quinic acid and of other substances in the animal body. Bul. Facultat. Stiinte Agr. Chisinau, Comun. Lab. Chim. Agr. 3:77-84.
1406. Velluda, C. C., B. Cuparencu, I. Ticsa, and V. Csutak. 1968. Changes in the cardiovascular actions of caffeine and adrenaline by ascorbic acid. Fiziol. Norm. Patol. 14(3):255-262.
1407. Velthorst, H. 1932. The preservative effect of some p-oxybenzoic acid esters. Pharmaz. Monatshefte 13:199-202.
1408. Verkade, P.E. 1920. The attackability of organic compounds by microorganisms. Zentralblatt Bakter. Parasitenk. II. Abt. 52:273-80.
1409. Vilar, J. 1931. A cause of error in the detection of benzoic acid in wine. Rev. Farm. (Buenos Aires) 73:225-8.
1410. Vincens, J., and G. Colomies. 1924. Benzoate of soda in wine making. Rev. Vit. 61:97-100.

1411. Vincent, H. 1928. Non-colloidal substances with cryptotoxic properties. *Compt. Rend. Acad. Sciences* 186:1175-1177.
1412. Vincent, H. 1931. The cryptotoxic properties of sodium salicylate. *Compt. Rend. Soc. Biol.* 108:756-757.
1413. Vincent, H. 1932. Treatment and prevention of serum sickness with benzoic and salicylic acids. *Bull. Acad. Med.* 107:549-52.
1414. Visweswaraiah, K. 1969. Chemical preservation of sardine fish to obtain a good grade fish oil (I). *J. Food Sci. Technol. (Mysore)* 6(2):103-105.
1415. Voegeli, M. M., and H. J. Gorsica, to B. Heller & Co. 1964. Composition for treating meat. U. S. Pat. 3,154,421, Oct. 27.
1416. Voets, J.P. 1963. Benzoate metabolism in *Azotobacter vinelandii*. *Ann. Inst. Pasteur* 105:383-408.
1417. Vogel, J., and J. Deshusses. 1965. Polarographic determination of small amounts of benzoic acid; application of the method for the determination of benzoic acid in milk and yoghurts. *Mitt. Lebensm. Hyg.* 56(1):63-7.
1418. Volmar, J. 1927. Use of fluorescence phenomena in analysis of food substances. *J. Pharm. Chim.* 5:435-43.
1419. Von Braun, J., O. Braunsdorf, and K. Rath. 1922. Relations between constituents and pharmacological effect in benzoic acid and tropic acid esters of alkamines. *Dtsch. Chem. Ges.* 58:601.
1420. Von Bubnoff, M., D. Schnell, and E. Schmid. 1956. Pharmacology of benzoic acid, p-chlorobenzoic acid, p-hydroxybenzoic acid, and its esters. *Arzneimittel-Forsch.* 6:364-9.
1421. Von Bubnoff, M., D. Schnell, and J. Vogt-Moykoff. 1957. Pharmacology of benzoic acid, p-chlorobenzoic acid, p-hydrobenzoic acid, and their esters. II. *Arzneimittel -Forsch.* 7:340-344.
1422. Von Fellenberg, T. 1925. The determination of benzoic acid in candied fruit. *Mitt. Lebensm. Hyg.* 16:6-15.
1423. Von Fellenberg, T. and S. Krauze. 1932a. Identification of preservatives. Proposals for the 4th edition of the Swiss book on foodstuffs. *Mitt. Lebensm. Hyg.* 23:111-37.
1424. Von Fellenberg, T., and S. Krauze. 1932b. The natural occurrence of benzoic acid in wine. *Mitt. Lebensm. Hyg.* 21:138-139.
1425. Von Kaulla, K. N. 1965. A simple test tube arrangement for screening fibrinolytic activity of synthetic organic compounds. *J. Med. Chem.* 8(2):164-166.

1426. V. Schelhorn, M. 1948. Activity and application of chemical preserving agents in food industry. Deut. Lebensm.-Rundschau 44:144.
1427. Von Schelhorn, M. 1949. Studies on the action of preservatives. The use of benzoic acid and sodium benzoate. I. Dtsch. Lebensmittel-Rundschau 45:255-56.
1428. Von Schelhorn, M. 1950. Preservatives. III. Comparison between the effectiveness of benzoic acid alone and in combination with other substances. Deut. Lebensm.-Rundschau 46:132-40.
1429. Von Schelhorn, M. 1951a. Studies on preservatives. 5. Comparison of preservative effectiveness. Dtsch. Lebensmittel-Rundschau 47:16-18.
1430. Von Schelhorn, M. 1951b. Studies on preservatives. 6. Effectiveness and application domain of benzoic acid, p-oxybenzoic acid esters and combinations of these compounds. Dtsch. Lebensmittel-Rundschau 47:128-34.
1431. Von Schelhorn, M. 1953a. Efficacy and specificity of chemical food preservatives. Food Technol. 7:97-101.
1432. Von Schelhorn, M. 1953b. Bacteriostatic and bactericidal action of preservatives. Arch. Mikrobiol. 19:30-44.
1433. Von Schelhorn, M. 1958. Resistance of yeast cells to preservatives. Z. Lebensm.-Untersuch. Forsch. 107:212-15.
1434. Von Schelhorn, M. 1959. Studies on the interaction of temperature and benzoic acid concentration on *S. cerevisiae*. Arch. Mikrobiol. 34(1):36-57.
1435. Vransky, J. 1960. Occurrence of bacteria assimilating benzoic acid and p-hydroxybenzoic acid in cereal rhizosphere and in soil. Folia Microbiol. 5(2):116-119.
1436. Vuilleumier, J.P. 1956. The source of benzoic acid in man and animals. Dissertation, Basel. Winterthur:Keller 52 pp.
1437. Wachi, T., T. Matsumoto, and N. Kita. 1959. The mechanism of inhibition by isonicotinicoyl hydrazide and its derivatives on vitamin B6-requiring enzymes. II. The mechanism of the inhibition on glutamic acid decarboxylase. Kekkaku 34:659-63.
1438. Waelsch, H., and A. Busztin. 1937. Enzymic formation of benzamide and hippuric acid. Z. Physiol. Chem. 249:135-156.
1439. Waelsch, H., and G. Klepetar. 1935. A method for determination of free and combined benzoic acid in biological material and the enzymic transformation of benzoic acid in horse kidney. Z. Physiol. Chem. 236:92-102.

1440. Wagner, B. 1968. Chemical preservatives used in alcohol-free beverages. *Tagesz. Brauerei* 65 (101/102):595-98.
1441. Wagner, B., and H. Vonderbank. 1949. Tuberculostatic effect of some primary amines. *Z. Ges. Exptl. Med.* 115:66-81.
1442. Wagreich, H., A. Abrams, and B. Harrow. 1940. Detoxication of benzoic acid by glucuronic acid in humans. Rate of detoxication. *Proc. Soc. Exptl. Biol. Med.* 45:46-9.
1443. Wahhab, A., and Zamir-Ud-Din. 1954. Retention of vitamin C in citrus juices. *Punjab Fruit J.* 18(68-69):8-17.
- * 1444. Waldo, J.F., J.M. Masson, W.C. Lu, and J. Tollstrup. 1949. The effect of benzoic acid and caronamide on blood penicillin levels and on renal function. *Am. J. Med. Sci.* 217:563-8.
1445. Walkenstein, S. S., R. Wiser, C. Gudmundsen, and H. Kimmel. 1964. Metabolism of gamma-hydrobutyric acid. *Biochim. Biophysica Acta (Amsterdam)* 86:640-642.
1446. Wallbach, G. 1932. Enlarged microscopic-chemical study on the influence of iron resorption. *Z. Ges. Exp. Med.* 83:657-681.
1447. Walton, R. P., R. P. Walton, Jr., and W. L. Thompson. 1959. Inotropic activity of catechol isomers and a series of related compounds. *J. Pharmacol. Exptl. Therap.* 125(3):202-207.
1448. Waltzinger, E. 1926. Determination of benzoic acid in egg yolk. *Chem.-Ztg.* 50:949.
1449. Waltzinger, E. 1927. Determination of benzoic acid in mince meat. *Chem.-Ztg.* 51:170.
1450. Wang, R.T., S.S. Chou, and C.H. Lin. 1969. Simple and rapid paper-chromatographic determination of preservatives and mimosine in soybean sauce. *Chung Kuo Nung Yeh Hua Hsueh Hui Chih* 7(1-2):14-26.
1451. Warth, F.J., and N.C.D. Gupta. 1928. A modified method for the determination of hippuric acid and free benzoic acid in the urine of cattle. *Biochem. J.* 22(3):621-627.
1452. Warth, F.J. 1930. Report of the physiological chemist. *Agr. Research Inst. Pusa. Sci. Repts.* 1928-29, 130-40.
1453. Warth, F.J., and N.C. Das Gupta. 1932. Starch in the formation of benzoic acid and phenols in animals. *Indian J. Veterin. Sci. Animal Husbandry* 2:281-88.
1454. Watanabe, A. and M. Takehara. 1954. Contributions to the knowledge of ornithuric acid formation in bird body. *J. Biochem. (Tokyo)* 41(3):397-400.

1455. Waterman, H.I., and P. Kuiper. 1924. The antiseptic action of benzoic acid, salicylic acid, cinnamic acid and their salts. *Rec. Trav. Chim.* 43:323-5.
1456. Weaver, E. A., J. F. Robinson, and C. H. Hills. 1957. Preservation of apple cider with sodium sorbate. *Food Technol* 11(12):667-669.
1457. Webb, R.E., E. Shah, and E.L.R. Stokstad. 1966. Effect of folic acid and vitamin B12 on excretion of hippuric acid and formiminoglutamic acid. *Proc. Soc. Exptl. Biol. Med.* 121(1):19-24.
1458. Weissler, A. 1962. Ultrasonic hydroxylation in a fluorescence analysis for microgram quantities of benzoic acid. *Nature (London)* 193:1070.
1459. Werschinin, A. A. 1949. Procedure improvement for salting fish from the Caspian Sea. *Rybnoye Khozyaistvo* 25(10):22-24.
1460. Wheaton, R. D., and F. W. Fabian. 1953. Green color in pickles. *Canner* 116(20):21-24; 116(22):30-32.
1461. Whelan, M., M.F. Jacobs, and N.M. Keith. 1927. The action of ammonium salts. *Am. J. Physiol.* 81:513.
- * 1462. White, A. 1941. Growth inhibition produced in rats by the oral administration of sodium benzoate. Effects of various dietary supplements. *Yale J. Biol. Med.* 13:759-768.
- * 1463. White, F. D., and A. Kerr. 1957. The effect of various denaturants on the haemoglobins adult and cord blood. I. Comparative rates of denaturation. *Canadian J. Biochem. Physiol.* 35(5):273-279.
1464. White, W.H., N.E. Gibbons, and M.W. Thistle. 1945. Canadian Wiltshire bacon. XXV. Chemical preservatives for maintaining quality at high storage temperatures. *Can. J. Research* 23F(6):340-50.
1465. Whiting, G.C., and R.A. Coggins. 1960. Organic-acid metabolism in cider and perry fermentations. II. Nonvolatile organic acids of cider-apple juices and sulfited ciders. *J. Sci. Food Agr.* 11:337-44.
1466. Widmark, E.M.P. 1926. Determination of free and combined benzoic acid by means of the shaking extraction procedure. *Biochem. Z.* 179:263-71.
1467. Widmark, E.M.P. 1932. The swing extraction methods. Pages 1935-1991 in E. Abderhalden, *Handbook of biological work methods*. Urban and Schwarzenberg, Berlin.
1468. Widmer, A. 1926. Preservation of fruit juices with sodium benzoate. *Schweiz. Apoth. Ztg.* 64:123-127.
1469. Widmer, A., O. E. Kalberer, and F. Braun. 1930. The preservation of fruit and grape juice with chemicals. *Landwirtschl. Jahrbch. Schweiz.* 44:521.

- * 1470. Wiley, H. M., and W. D. Bigelow. 1908. Influence of benzoic acid and benzoates on digestion and health. Bulletin 84, Pt. IV, Bureau of Chemistry, U. S. Department of Agriculture.
- 1471. Wilkmar, M.N. 1951. Egg preserving. Swed. Pat. 132,305, July 10.
- 1472. Willheim, R. 1929. A neutral salt-treated, newly coagulable solution of protein coagulants. Kolloid-Z. 48:217-231.
- 1473. Williams, C.M. 1962. Gas chromatography of urinary aromatic acids. Anal. Biochem. 4:423-32.
- * 1474. Williams, R. T. 1959. The metabolism of aromatic acids. Pages 348-389 in R. T. Williams, Detoxication mechanisms, 2nd edit. Chapman's Hill, London.
- 1475. Wilmes, G., and H. Kreis. 1969. Reciprocal detoxification of benzoic acid and glycine. Bibl. "Nutr. Dieta" No. 11:15-22.
- 1476. Winitz, M., J. Graff, N. Gallagher, A. Narkin, and D. A. Seedman. 1965. Evaluation of chemical diets as nourishment for men in space. Nature (London) 205:741-743.
- 1477. Winkler, J. 1955. A preservative. U.S. Pat. 2,722,488, Nov. 1.
- 1478. Winsley, B.E., and V. Walters. 1965. The influence of pH upon the antifungal activity of phenol and benzoic acid. J. Pharm. Pharmacol. 17(Suppl.):22S-27S.
- 1479. Winther, O. 1960. Biological demonstration of preservatives in meat and other products. Nord. Veterinaarmed. 12:245-260.
- 1480. Woeber, K.A., and S.H. Ingbar. 1964. Effects of noncalorigenic congeners of salicylate on the peripheral metabolism of thyroxine. J. Clin. Invest. 43(5):931-42.
- 1481. Woehlich, E., and L. Juehling. 1938. Activation of a plasma-fibrogenase using hydrotropic substances. Naturwiss. 26:548.
- 1482. Woidich, K., L. Schmid, and H. Gnauer. 1956. Potentiometric titrations in food analyses. Z. Lebensm.-Untersuch. Forsch. 104:97-104.
- 1483. Wojtulewski, L. 1939. The influence of benzoic acid on the excretion of uric acid by human beings. Acta Biol. Exptl. (Warsaw) 13:49-56.
- 1484. Wolf, K. M., F. Legler, and R. Hohenner. 1950. Penicillin level movement in the blood by the use of different penicillins with or without simultaneous dispersion of caronamide (4'-carboxyphenyl-methansulfonamide). Med. Klin. 45:70-73.
- 1485. Wolff, H. G., and W. Horsley Gantt. 1935. Caffeine sodiobenzoate, sodium iso-amylethyl barbiturate, sodium bromide and chloral hydrate: effect on the highest integrative functions. Arch. Neurol. Psychiatry 33(5):1030-1057.

1286. Wong, N.P., and O.W. Parks. 1968. Simple technique for extracting flavor compounds from fatty foods. *J. Dairy Sci.* 51(11):1768-1769.
1487. Woo, C.H., S.K. Kim, and S.H. Min. 1967. Complex interaction of acacia and sodium alginate with certain preservatives (spectrophotometric studies). *Yakhak Hoeji* 11(3-4):27-32.
1488. Woodward, G.J., L.B. Kingery, and R.J. Williams. 1935. The fungicidal power of phenol derivatives. II. Strength in the presence of proteins. *J. Lab. Clin. Med.* 20:950-3.
1489. Wouters, O. J. 1964. Method for keepably packing dried and resoaked fruit in foils. *U. S. Pat.* 3,119,700, Jan. 28.
1490. Wu, H., and H.C. Elliott, Jr. 1961. Urinary excretion of hippuric acid by man. *J. Appl. Physiol.* 16:553-6.
1491. Wuerdig, G. 1966. Gas chromatographic determination of sorbic acid and benzoic acid in wine. *Deut. Lebensm.-Rundschau* 62(5):147-149.
1492. Wurziger, J. 1965. Valuation of common commercial fish preserves. *Deut. Lebensmittel-Rundschau* 61:108-14.
1493. Wyss, A.P., and C.F. Poe. 1945. Study of the germicidal values of benzoic acids and benzoates. *Proc. Inst. Food Tech.* 21-7.
1494. Yagi, K., J. Okuda, T. Ozawa, and K. Okada. 1957. Inhibition mechanism of phenolic acid derivatives on D-amino-acid-oxydases. *Symposia Enzyme Chem. (Tokyo)* 12:41-48.
1495. Yagi, K., T. Ozawa, and M. Harada. 1959. Change of absorption spectrum of flavine adenine dinucleotide by its binding with both D-amino acid oxidase apo-protein and benzoate. *Nature* 184(Suppl. 25):1938-1939.
1496. Yagi, K., T. Ozawa, and K. Okada. 1959. Mechanism of inhibition of D-amino acid oxidase. II. Inhibitory actions of benzene derivatives. *Biochim. Biophys. Acta* 35:102-10.
1497. Yagi, K., and T. Ozawa. 1962. Complex formation of apo-enzyme, coenzyme and substrate of d-amino acid oxidase. II. Spectrophotometric analysis using a substrate-substitute. *Biochim. Biophys. Acta* 56:413.
1498. Yagi, K. 1963. Enzyme-substrate complexes. *Tampakushitsu Kakusan Koso* 8(1):1-8.
1499. Yagi, K. and M. Harada. 1965. Determination of benzoic acid in D-amino acid oxidase-benzoate complex crystal. *J. Biochem. (Tokyo)* 57(4):463-6.

1500. Yamamoto, H. 1956. Influences of inhibitors on bile pigment formation in vitro. I. Significance of denatured globin treated with inhibitors on the process of verdohemoglobin formation from hemoglobin. Igaku Kenkyu 26:2464-2474.
1501. Yamamoto, S., Y. Ito, and S. Noda. 1967. Toxicity test of food additives by the disturbance of life cycles of chlorella and Saccharomyces cerevisiae var. sake. II. Bacteriostatic or bactericidal action of food preservatives and antimicrobials I. Shokuhin Eiseigaku Zasshi 8(5):408-419.
1502. Yang, H. Y., L. P. Gomez. M. L. Rasulpuri, and J. G. Michalek. 1962. The effect of vitamin K on gas formation in fruit juices. Food Technol. 16(4):109-111.
1503. Yamamura, Y., and Y. Sasakawa. 1950. Benzoic acid metabolism of the tuberculosis bacteria. Symposia on Enzyme Chem. (Japan) 5:60-74.
1504. Yamasaki, H., and K. Saeki. 1967. Inhibition of mast-cell degranulation by antiinflammatory agents. Arch. Int. Pharmacodyn. Ther. 168(1):166-79.
1505. Yokotsuka, T. 1953. Flavoring substances in soy sauce. IX. Flavors with higher boiling points. 4. Isolation of phenolic flavoring substances. J. Agr. Chem. Soc. Japan 27:276-81.
1506. Yokotsuka, T. 1958. Flavoring substances in soy sauce. XV. In heated soy sauce. 2. Nippon Nogei Kagaku Kaishi 32:23-6.
1507. Yosii, S. 1937. Fatty acid oxidation in animals. J. Biochem. 26:397-424.
1508. Yosimura, K. 1941. Effect of benzene and its derivatives on pupil of isolated frog eye. Japan. J. Med. Sci. IV. Pharmacol. 13:149-206.
1509. Youatt, J. 1960. Absorption of isoniazid and related compounds by microbacterias. Austral. J. Exp. Biol. Med. Sci. 38:331-37.
1510. Young, J.H. 1968. The science and morals of metabolism; catsup and benzoate of soda. J. Hist. Med. 23:86-104.
1511. Yufera, E.P., J.S. Parareda, and J. Alberola. 1963. Detection of citrus juice adulteration. I. Processes for determination of acids in orange juice through thin-layer chromatography. Rev. Agroquim. Tecnol. Alimentos 3:349-56.
1512. Yufera, E.P., J. Sanchez, and J. Alberola. 1965. Detection of adulteration in citrus juices. III. Identifications of nonvolatile acids in orange juices from the United States. Rev. Agroquim. Tecnol. Alimentos 5(1):121-4.

1513. Yufera, E.P., J.S. Parareda, and J. Aberola. 1965. Detection of adulterations in citrus juices. IV. Nonvolatile acids and amino acids as impurities in citric acid fermentation. *Rev. Agroquim. Technol. Alimentos* 5(2):211-15.
1514. Zach, C. 1930. The detection of benzoic acid in wine. *Mitt. Lebensm. Hyg.* 21:244-7.
1515. Zaugg, H.E. and B.W. Horrom. 1948. Lithium aluminum hydride as a quantitative reagent in the modified Grignard apparatus. *Anal. Chem.* 20:1026-9.
1516. Zeller, H. 1927. Studies on the effect of the combination of two substances on fermentation. VIII. *Biochem. Z.* 183:389-407.
1517. Zeller, E.A. and A. Maritz. 1945. A new 1-amino-acid-oxydase (ophio-1-amino acid-oxydase). II. *Helvetica Chim. Acta* 28(2):365-379.
1518. Zieve, L., and M. Hanson. 1953. Liver-function tests. IV. Effect of repeated injections of sodium benzoate on the formation of hippuric acid in patients with liver disease. *J. Lab. Clin. Med.* 42:872-876.
1519. Zipf, K. 1930. Does the inhibition of caffeine effect in the muscle by sodium salicylate and novocain hydrochloride occur by means of a complex compound formation? *Ztschr. Physiol. Chem.* 187:214-228.
1520. Zsinka, A. J., and T. Kemeny. 1968. Effect of (food) preservatives on the exocrine pancreatic secretion. *Kiserl. Orvostud.* 20(6):624-633.
1521. Zsinka, A. J., T. Kemeny. 1968. Effect of preservatives on the exocrine pancreas: diethyl pyrocarbonate, sodium benzoate, and sodium salicylate. *Nahrung* 12(7):695-700.
1522. Anon. 1924. Recognition and determination of saccharin and benzoic acid in food supplements. *Zeitschr. Ges. Kohlensäure-Ind.* 30:145-46.
1523. Anon. 1925. Detection of benzoic acid in wines. *Ann. Fals.* 18:212-4.
1524. Anon. 1930. Sodium benzoate in fruit juices. *Fruit Prod. J. Am. Vinegar Ind.* 9(11):345-346.
1525. Anon. 1937. Separate emulsions, fats and waxes. *Seifensieder-Ztg.* 64:971-972.
1526. Anon. 1955. The use of sodium benzoate to prevent fermentation in fruit juices. *Conserv. e Deriv. Agrumari (Palermo)* 4(14):56-58.
1527. Anon. 1963. Chemical preservatives in food. *Br. Med. J.* 5311:1042-1043